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Seasonal Subsistence in Late Woodland Southwestern Ontario: An Examination of the Relationships Between Resource Availability, Maize Agriculture, and Faunal Procurement and Processing Strategies

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A thesis submitted in partial fulfillment of the requirements for the degree in Doctor of Philosophy

SEASONAL SUBSISTENCE IN LATE WOODLAND SOUTHWESTERN ONTARIO: AN EXAMINATION OF THE RELATIONSHIPS BETWEEN RESOURCE AVAILABILITY, MAIZE AGRICULTURE, AND FAUNAL PROCUREMENT AND PROCESSING STRATEGIES

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ABSTRACT

This study uses the zooarchaeological record to examine seasonal mobility and scheduling of faunal procurement and processing activities by southwestern Ontario's two Late Woodland (ca. A.D. 800-1600) communities, Western Basin and Iroquoian. Faunal datasets collated from a number of Western Basin sites are combined to reconstruct the timing and location of annual hunting and fishing pursuits. A greater degree of flexibility in the scheduling and organization of these activities within the local environment is identified than was previously recognized.

From the spring until the fall, Western Basin fishers intensively harvested lake- and river-dwelling species. This aquatic orientation is also reflected in the abundance of muskrat and waterfowl in the assemblages. In winter, some groups remained near the lakes to hunt and fish, while others moved to the interior where they procured deer, other mammals, and birds. The overall picture is of a relatively high degree of mobility, flexibility, and variability within their seasonal round.

In comparison, the Iroquoian groups inhabiting the same region were much more stationary, locating many of their camps and villages in upland areas near tributaries, creeks, and/or ponds, from which a number of different habitats could be easily accessed. Hunters and fishers belonging to this community emphasized the exploitation of locally available animal resources, especially cervids.

During the 800 years of interest, Western Basin and Iroquoian peoples combined hunting, fishing, and collecting with the growing of introduced squash, maize, sunflower, tobacco, and bean crops. The faunal data indicate that by A.D. 1200, both traditions diversified their faunal procurement activities de-emphasizing cervid hunting and targeting several other animals. At the same time, hunting and fishing became more focused on the resources available near

their settlements. These changes in faunal exploitation helped to facilitate the scheduling of domestic crop production.

The cause(s) behind the extensive fragmentation of Western Basin cervid (deer) assemblages is also investigated. Categorizing large mammal specimens by bone size, type (i.e., cancellous bone, cortical bone), element, fracture characteristics, and degree of burning demonstrates a practice of separating appendicular (i.e., long bones, phalanges) and axial (i.e., cranium, vertebrae, ribs) elements during processing for bone marrow and grease. These activities were carried out year-round between A.D. 800 and 1600, suggesting that bone grease was important to Western Basin food preparation and consumption.

Key Words:

seasonality, subsistence, settlement, Late Woodland period, southwestern Ontario, mobility, maize agriculture, zooarchaeology, carcass processing, Western Basin, Iroquoian

DEDICATION

This research is dedicated to the memory of my grandmother, Barbara Elizabeth Watson McOustra Blong (1921-2008).

Nana,

Thank you for giving me the courage and strength to finish what I started, for believing in me, and for always listening.

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CHAPTER I

INTRODUCTION

This dissertation is a collection of articles demonstrating how faunal data from Late Woodland southwestern Ontario contexts can be used to delimit the nature of Western Basin seasonal mobility, the distinct hunting, fishing and land-use preferences of the region's Western Basin and Iroquoian communities, and the influence of Western Basin processing and discard practices on assemblage formation and preservation. Different aspects of the zooarchaeological record are examined in each chapter in order to accurately reconstruct the faunal procurement and preparation choices of members of these archaeological traditions between A.D. 800 and 1600. Chapters 2 and 3 investigate these strategies at the regional scale, while Chapter 4 examines them at the intra-site level. The topics progress from site seasonality and reconstructing a seasonal subsistence round, to an examination of long-term patterns of faunal procurement, and finally to understanding the natural and cultural processes influencing faunal assemblage creation. The final integrated body of work incorporates several important zooarchaeological research themes, illustrating how they are suited to interpreting the faunal exploitation strategies of southwestern Ontario's precontact native communities.

Research Objectives

This study demonstrates the importance of incorporating zooarchaeological analyses into regional and temporal reconstructions of human mobility within, and perceptions of, the surrounding environment. Such an approach provides valuable insight into the subsistence and settlement choices of southwestern Ontario's Late Woodland native communities between A.D. 800 and 1600 (Figure 1.1). During the past century and a half, Late Woodland archaeology in Ontario has focused on the Iroquoian material record, leading to the definition (Wright 1966), and continued refinement of (e.g., Dodd et al. 1990;

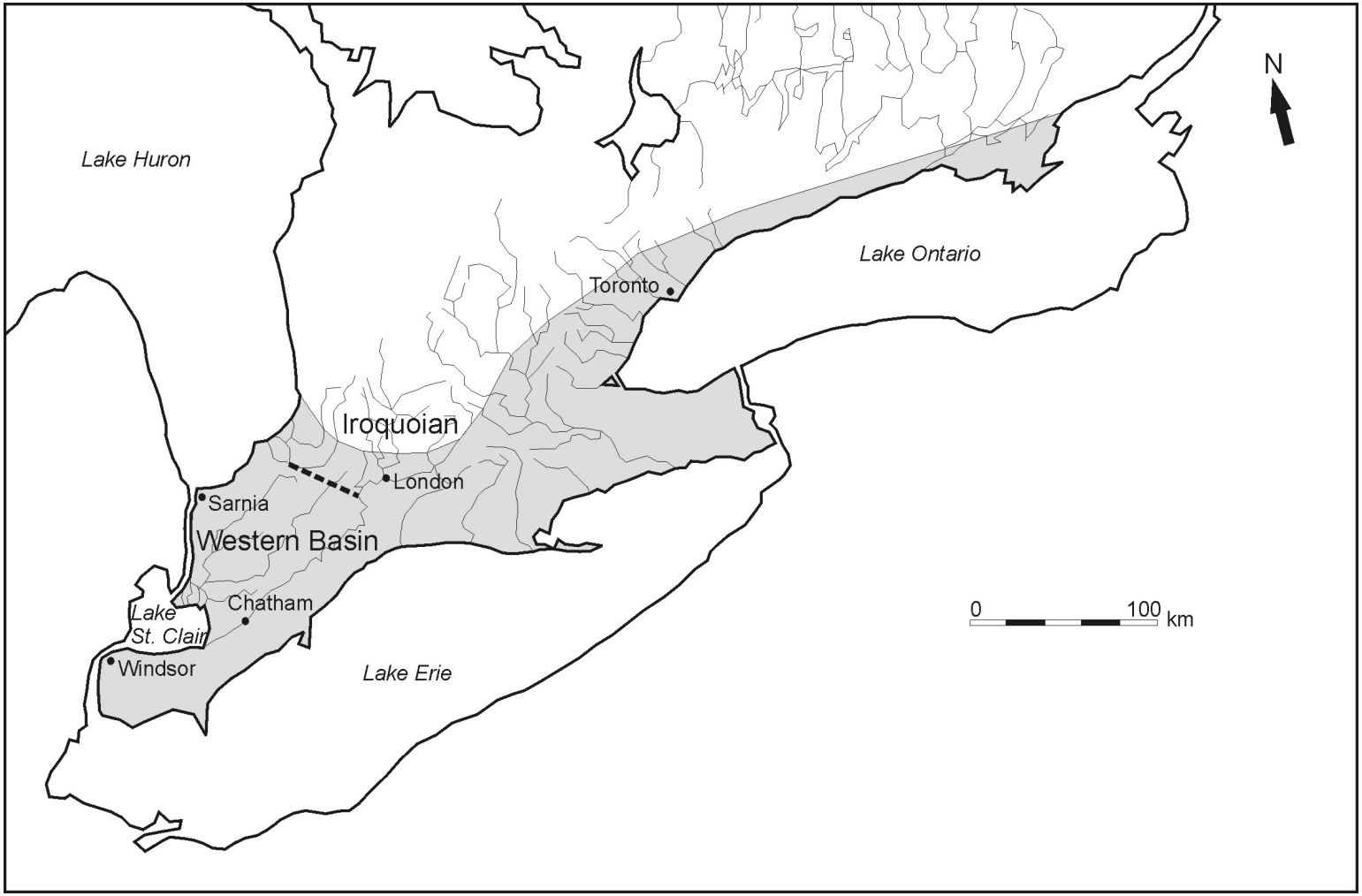

Figure 1.1. Southern Ontario's archaeological landscape, A.D. 800-1600. Dotted line is the eastern-most zone of Western Basin and Iroquoian contact. Shaded area is the current northern limit of the Carolinian forest.

Ferris 1999; Ferris and Spence 1995; Lennox and Fitzgerald 1990; D. Smith 1990, 1997; Warrick 2000, 2008; Williamson 1990), the Ontario Iroquois (Iroquoian) Tradition. This study examines their less well-known neighbours to the southwest, members of the Western Basin Tradition, and uses the subsistence and settlement practices of both groups to model Western Basin annual mobility.

Faunal data were collated from published sources, unpublished sources, and the original analyses of four additional assemblages. The compiled information is examined in order to: (1) demonstrate how the zooarchaeological record can be used to reconstruct Western Basin seasonal hunting and fishing pursuits; (2) compare Western Basin and Iroquoian hunting and fishing patterns in southwestern Ontario between A.D. 800 and 1600, and examine culture-specific land-use patterns; (3) identify whether and how the increase in domestic crop production over time by both Late Woodland traditions affected their faunal exploitation strategies; (4) reconstruct the taphonomic history of the extremely fragmented cervid (deer) assemblages commonly recovered from Western Basin sites; and (5) reconstruct Western Basin practices of cervid processing and disposal. The following sections provide background on Late Woodland archaeology in southwestern Ontario, the use of the zooarchaeological record to reconstruct subsistence practices and season of site occupation, the influence of agricultural development and intensification on hunting and fishing activities, and the study of taphonomy in southwestern Ontario.

Late Woodland Archaeology in Southwestern Ontario

Archaeologists working in northeastern North America or the Northeast, defined here as Atlantic Canada (Newfoundland, Prince Edward Island, New Brunswick, Nova Scotia), New England (Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, Connecticut), and the provinces and states surrounding the central and lower Great Lakes (Quebec, Ontario, New York, New Jersey, Pennsylvania, Ohio, Michigan) (Crawford and Smith 2003:173; Kerber 1997:81; MacNeish 1952:46; Rieth 2002:1; Trigger 1978:1-3), have extensively

studied the patterns of subsistence and settlement favoured by the precontact native communities who occupied this region. They have been particularly concerned with the period between 500 B.C. and A.D. 1600, which represents the 2000 years just prior to and the 100 years following the arrival of European explorers and missionaries in North America. The analysis of archaeological evidence from hundreds of well-preserved sites suggests that this was a period of rapid population growth, characterized by more complex social and political organization and increasing contact between communities.

Prior to the 1960s, most Ontario archaeology fell within the avocational and academic branches. Since this time the majority of sites have been identified and investigated by cultural resource management (CRM) archaeologists in advance of land development. Many of the mitigated areas in the southwestern portion of the province represent Late Woodland settlements that were once occupied by members of the Western Basin and Ontario Iroquoian Traditions.

The geographic area of interest is bounded by the southeastern basin of Lake Huron to the north, the St. Clair River, Lake St. Clair, and Detroit River to the west, Lake Erie to the south, and the Niagara River and western end of Lake Ontario to the east (Figure 1.1). It encompasses the region located between present-day Sarnia and Windsor and the Greater Toronto Area (GTA), and falls within the current northern limit of the Carolinian forest. Unique combinations of deciduous, coniferous, and grassland habitats are dispersed throughout this area (The Centre for Land and Water Stewardship, University of Guelph 1994; Colthurst and Waldron 1993; Kavanagh et al. 1999; Waldron 2003), and are located within a variety of physiographic regions, the most prominent of which include till plains, sand plains, clay plains, moraines, and the Niagara escarpment (Chapman and Putnam 1984). Both historic records (see Ferris 1989; Tooker 1967) and contemporary biological studies (e.g., The Centre for Land and Water Stewardship, University of Guelph 1994; Colthurst and Waldron 1993; Kavanagh et al. 1999) describe the diversity of animal species occupying this rich ecosystem. Archaeological evidence (e.g., Burns 1972; Prevec 1981, 1988; B.A.

Smith 1981) indicates that the same range of species was present in the area between A.D. 800 and 1600.

Peoples belonging to the Western Basin Tradition occupied the southwestern-most portion of the province, from present-day Sarnia and Windsor to London, while the Iroquoians inhabited the area from present-day Chatham east to the GTA. These contemporaneous archaeological traditions are each divided into four temporal phases, defined by material cultural attributes, subsistence, and settlement pattern data (Dodd et al. 1990; Fox 1990; Lennox and Fitzgerald 1990; Murphy and Ferris 1990; Warrick 2000; Williamson 1990; Table 1.1).

Table 1.1. Southwestern Ontario's Archaeological Traditions, A.D. 500-1700

Tradition	Phase	Temporal Range (A.D.)	Sources
Western Basin	**Riviere au Vase**	500-900	Murphy and Ferris (1990)
	Younge	800-1200	
	Springwells	1200-1400	
	Wolf	1400-1600	
Ontario Iroquoian[1]	**Princess Point**	500-1000	Ferris (1999:19);
	Early Iroquoian	900-1300	Ferris and Spence (1995);
	Glen Meyer, Pickering		D. Smith (1997);
	Middle Iroquoian	1300-1400	Warrick (2008:109);
	Uren, Middleport		Wright (1966)
	Late Iroquoian	1400-1700	
	Neutral		

[1] – Following D. Smith (1990:279) and Trigger (1978:3), the term *Iroquoian* describes hypothesized precontact, contact, and historic Iroquoian-speaking groups who occupied the lower Great Lakes region, while the term *Iroquois* is reserved for the historic Five Nations (i.e., Onondaga, Oneida, Mohawk, Seneca, and Cayuga) of New York State.

In general, both cultures practiced a mixed subsistence economy in which they combined the hunting and fishing of locally available animals and collecting of plants with the growing of domestic crops, including squash, maize, sunflower, beans, and tobacco. Cervids, particularly white-tailed deer, and a variety of small to medium mammals were preferentially hunted, while the diversity of lower Great Lakes fish was also exploited throughout the spring and summer. Members of these communities occupied a number of distinct settlement types, varying in size, function, and location within the region. The settlement pattern data from Western Basin and Iroquoian sites in southwestern Ontario suggest

frequent re-occupation of the same locales by both groups during the 800 years of interest.

Until quite recently, many Ontario archaeologists (e.g., Dodd et al. 1990; Lennox and Fitzgerald 1990; Murphy and Ferris 1990; Warrick 2000; Williamson 1990) shared the opinion that Iroquoian peoples were more stationary and more heavily invested in maize agriculture than their seasonally mobile Western Basin neighbours. Research conducted over the past decade suggests, however, that domestic crops were equally important to the Western Basin diet (Dewar et al. 2010; Watts et al. 2011). As a result, we must now revisit our understanding of the subsistence and settlement choices and underlying social organization of these two traditions. This study does so using the available zooarchaeological evidence.

Assembling the Dataset

This is the first attempt to synthesize the Late Woodland faunal data collected during several decades of rigorous academic and salvage archaeology in southwestern Ontario (Ferris 1998). Zooarchaeological analyses of assemblages dating to this period have consistently been conducted since the early 1970s (e.g., Burns 1972). For the most part, researchers have focused on reconstructing the timing and location of community hunting and fishing activities and their contribution to the subsistence economy. This study examines Late Woodland faunal procurement practices at the regional level by combining the work of many Ontario zooarchaeologists.

The first step was to assemble all faunal reports in the published and grey literature from sites dating between A.D. 800 and 1600. After the temporal gaps in the identified Western Basin faunal assemblages were determined, the zooarchaeological material from four additional Western Basin sites was acquired and analyzed. Appendix A summarizes the Western Basin and Iroquoian datasets studied during the course of this research programme.

The data presented here are counts of the number of identified specimens (NISP) or percentages of the total NISP per assemblage. This method of quantification is calculated the same way by all analysts, unlike the minimum

number of individuals (MNI), a derived measure that can be calculated a number of different ways, and is thus comparable between assemblages. It also facilitates the collation of datasets by temporal period and/or archaeological tradition in order to identify changes in faunal exploitation strategies over time, as well as within and between traditions.

A Zooarchaeological Approach for Reconstructing Subsistence and Seasonality

Animal bones are recovered from a variety of archaeological contexts and represent human use for food and a range of other purposes including tool manufacture, gaming, personal adornment, and spiritual or ritual activities. Most commonly, they are recovered from kill sites, areas designated for the preparation and consumption of meals, hearths where the scraps were often burned, refuse and storage pits, and refuse dumps, known as middens. Zooarchaeologists examine the recovered animal specimens in order to identify which animals were procured and their approximate quantities.

Faunal analysts use historic records and contemporary biological studies of modern animals to reconstruct the timing and locations of prehistoric exploitation activities. Given the seasonal variation in the availability of many animals in the lower Great Lakes region, this is an important exercise for understanding group mobility and social organization in the environment. Seasonality is defined here, following Huss-Ashmore (1988:5), as “regular, recurring intra-annual fluctuation” and this study is most concerned with the influence of climatic seasonality, specifically, the fluctuations in temperature and rainfall that affect food availability and the timing and intensity of food procurement activities (Huss-Ashmore 1988:5).

The geographic distribution, habitat preferences, timing of migration, mating, birthing, and growth cycles, and rearing practices of fauna are used to predict the annual availability of archaeologically important species. All zooarchaeological seasonal studies assume that within the geographic region of interest, past animals grew and aged at the same rate as their contemporary counterparts (Monks 1981). Fish and migratory mammals and birds, which are

usually only available for a limited time during the year, are especially useful for seasonality estimates (Davis 1987:76; Monks 1981:180, 181; Pike-Tay 1991:20-22).

Most zooarchaeologists examine a suite of taxonomic categories, ranking them by abundance to identify the procurement focus of a site, and examine the combination of species recovered to approximate the length of time a group remained in the area. Researchers recognize that the season of animal procurement does not necessarily represent the season of site occupation (Monks 1981:223), and that the actions of the people who inhabited a site often complicate our efforts to determine when they were in a given locale. Mammals and birds hunted, and fish netted and processed in one area, were often preserved and stored for later consumption. These resources were then used, transported, or traded for other items (e.g., skins, stone, antler) as the situation required and in many cases, they ended up some distance from their origin. In order to provide the most accurate estimate of site seasonality, the abundance, not just the presence or absence of identified species, must be considered. Such an approach pinpoints the period of intensive exploitation within a given locale and suggests species, usually present in low numbers, which had a supplementary role and/or were transported to the site, procured prior to its main occupation.

Agriculture in Southern Ontario: Introduction, Adoption, and Intensification

The introduction and adoption of agriculture occurred much later in the lower Great Lakes region (i.e., during the last 3000 years) than it did in many other parts of the world (e.g., Flannery 1969). Research emphasis over the past half century has been on the acquisition of the earliest evidence of squash, maize, sunflower, beans, and tobacco in Ontario, and on determining when the first four crops became major dietary staples (e.g., Crawford et al. 1997; Crawford and Smith 2003; Harrison and Katzenberg 2003; Katzenberg 2006; Katzenberg et al. 1995; Saunders 2002; Schwarcz et al. 1985; D. Smith 1997; D. Smith and Crawford 1997). The timing of these events is less well known in

Ontario compared to other parts of the Northeast, and is summarized in Table 1.2.

Table 1.2. Earliest evidence of domestic crops in the Northeast and Ontario

Cultivar	First Evidence in the Northeast	First Evidence in Ontario
Squash	Between 5150 and 2300 B.C. (Chomko and Crawford 1978; B.D. Smith 1989; Yarnell 1993)	Unknown, likely the first domesticate in the province given its early presence in New York State (Hart et al. 2007; Hart and Siddell 1997), Ohio, and Michigan (Yarnell 1993:19)
Maize	Calibrated 320 B.C. (Hart et al. 2007)	By A.D. 500 (Crawford et al. 1997; Harrison and Katzenberg 2003:241; D. Smith 1997) Not abundant in the material record until after A.D. 1000 (Harrison and Katzenberg 2003; Katzenberg 2006; Katzenberg et al. 1995; Schwarcz et al. 1985)
Sunflower	Between 2000 and 1000 B.C. (B.D. Smith 1989; Yarnell 1976)	By A.D. 1000 (Crawford and Smith 2003; Saunders 2002)
Tobacco	Between A.D. 100 and 200 (Riley et al. 1990)	By A.D. 1000 (Crawford and Smith 2003; Saunders 2002)
Beans	Around A.D. 1200 (D. Smith and Crawford 1997:26) Also calibrated A.D. 1300 (Hart and Scarry 1999; Hart et al. 2002)	Around A.D. 1200 (D. Smith and Crawford 1997:26)

This chronology implies that the three sisters, maize, squash, and beans became the major horticultural focus of southwestern Ontario native groups only a few centuries prior to contact (Fritz 1995:7; Hart and Scarry 1999; Hart et al. 2002). It appears that the practice of maize intercropping (i.e., the growing of squash, beans, and other plants between rows of maize) was a rather late development in the region (Hart and Scarry 1999). In southwestern Ontario, the intensification of maize agricultural practices likely occurred some time between A.D. 1000 and 1200 (Crawford and Smith 2003:217; see also Harrison and Katzenberg 2003; Katzenberg et al. 1995; Schwarcz et al. 1985). The resultant effects on the faunal exploitation strategies of the two Late Woodland traditions occupying this portion of the province are examined in this dissertation.

Understanding Southwestern Ontario Taphonomy

A science in itself, taphonomy is the study of "the laws of embedding or burial" (Lyman 1994:1) or "processes that operate on organic remains after death to form fossil deposits" (Gifford 1981:366). In zooarchaeology, taphonomic studies examine "the post-mortem, pre- and post-burial histories of faunal remains" (Lyman 1987:94, 1994:3) with an emphasis on reconstructing the human treatment of animals, timing and location of final discard, post-depositional disturbance and alteration, and impact of excavation techniques on the recovered assemblage. In general, bone assemblages are affected by processes "that cause differential destruction, or attrition, of certain elements and those that cause selective transport of certain elements to or away from the locale of deposition" (Gifford 1981:400). During the past decade, emphasis has been placed on understanding how different natural and/or cultural processes can produce assemblages with similar characteristics, a concept known as equifinality (Lyman 2004; Rogers 2000).

Overall, Ontario's Late Woodland faunal assemblages demonstrate intensive fragmentation. This includes the Western Basin sites examined here, as well as many of the known Iroquoian faunal assemblages (e.g., Prevec 1983; Thomas et al. 1998; Warrick 1978; Williamson 1985). To date, no attempt has been made to quantify the degree of fragmentation, especially within the mammal components of these assemblages, large proportions of which usually cannot be identified beyond the class level.

Given that the largest and most abundant game animals available to these groups belonged to the cervid family, the majority of the indeterminate mammal specimens identified in Late Woodland assemblages likely represent the procurement and processing of white-tailed deer and elk. Following Outram (1998, 2001), this study examines the extent of fragmentation of the cervid and large mammal (assumed to be cervid) assemblages recovered from four Western Basin contexts to better understand their taphonomic history and to glean as much information as possible from the abundance of small undiagnostic fragments. This case study demonstrates the utility of such an approach in

deciphering assemblage formation processes and preservation in southern Ontario.

Structure of the Dissertation

This section introduces the datasets, methods of analysis, and research emphases for each chapter. It highlights the seasonal and culture-specific subsistence and settlement information that can be derived from the Late Woodland southwestern Ontario zooarchaeological record.

Chapter 2 uses faunal data from 10 Western Basin sites, dating between A.D. 800 and 1400, to illustrate how to estimate season of site occupation based on the range of exploited fauna at each site. The seasonality information is combined to reconstruct the Western Basin annual subsistence round. Emphasis is placed here on the scheduling and locations of their preferred hunting and fishing activities.

Chapter 3 examines temporal trends in faunal exploitation between A.D. 800 and 1600 by comparing the assembled Western Basin zooarchaeological dataset to the Iroquoian one (Appendix A). The procurement strategies of these two communities are evaluated and the relationship between increased crop production and the scheduling of hunting and fishing pursuits is examined. Above all, this chapter provides an up-to-date summary of Western Basin and Iroquoian faunal exploitation practices during a critical 800-year period in southwestern Ontario prehistory.

Chapter 4 examines Western Basin cervid assemblage formation by quantifying both the identifiable and unidentifiable large mammal specimens. In order to determine how, why, and when these assemblages became extensively fragmented, a variety of characteristics including bone type, element, degree of burning, degree of weathering, and fracture freshness index, are examined. Together these data help to interpret intra- and inter-site patterns of Western Basin cervid processing and disposal between A.D. 800 and 1600 and assess the variability associated with these activities.

Chapter 5 summarizes the major findings of this research programme, discusses them in light of their contribution to Ontario archaeology and zooarchaeology, and describes a number of topics for future investigation. Data, figures, and statistics that support and verify the trends noted throughout the dissertation are provided in the appendices.

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CHAPTER II

RECONSTRUCTING SEASONAL SUBSISTENCE PATTERNS USING THE ZOOARCHAEOLOGICAL RECORD: A LATE WOODLAND CASE STUDY FROM SOUTHWESTERN ONTARIO (A.D. 800-1400)

This paper demonstrates how prehistoric subsistence and settlement patterns and seasonal rounds can be reconstructed using the zooarchaeological record from southwestern Ontario. After first reviewing the biological and geographic concepts that are the backbone of zooarchaeological analysis, the interpretive utility of this method will be illustrated by examining Late Woodland Western Basin hunting and fishing practices at 10 sites (Figure 2.1) dating between A.D. 800 and 1400. Species abundance data, tied to site location and environmental setting, delimit when, over the course of the year these activities were carried out by families and communities. The seasonal mobility of these peoples suggested by the zooarchaeological record is supported by other subsistence (e.g., isotopic, macrobotanical; see Dewar et al. 2010; Watts et al. 2011; Ferris and Wilson 2009) and settlement (see Archaeologix Inc. 2004, 2008; Ferris and Wilson 2009; Murphy and Ferris 1990) datasets recovered from southwestern Ontario contexts.

Archaeologists who study prehistoric foraging groups such as the Western Basin Tradition frequently organize the seasonality data collated from a number of sites into a simplified seasonal round. While this approach tends to average the seasonal variability observed between sites and overemphasizes predictable responses (Cross 1988:56, 57), it provides a more complete understanding of the annual subsistence options and the movement of individuals and families within the environment. This study examines the seasonality of Western Basin sites in southwestern Ontario as a means of exploring the mobility of these groups between A.D. 800 and 1400. Earlier interpretations (Murphy and Ferris 1990) suggested that Western Basin people wintered in the interior, away from the shores of Lakes Huron, St. Clair, and Erie and the St. Clair and Detroit Rivers,

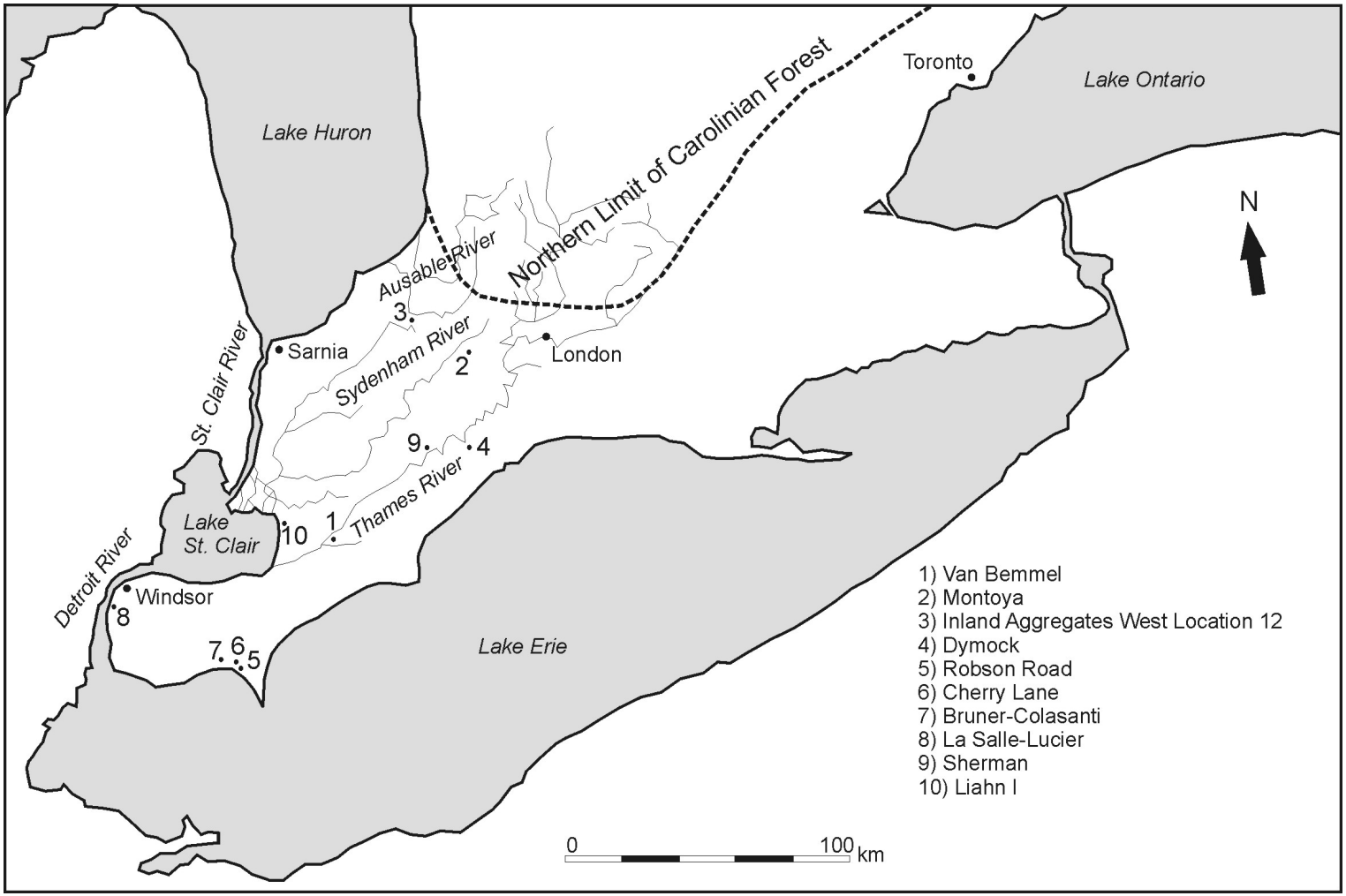


Figure 2.1. Western Basin site locations and major drainages in southwestern Ontario, A.D. 800-1400.

where small family groups concentrated on exploiting deer and other mammals. In spring and summer, they variably occupied multiple lake and river sites to exploit seasonally abundant resources across the region. A closer examination of the faunal evidence from selected Western Basin sites indicates a higher degree of flexibility in hunting and fishing activities, settlement location, length of site occupation, and group size throughout the year than was previously recognized.

Reconstructing Seasonality Using the Zooarchaeological Record

The analysis of faunal remains can be used to determine where and at what time of year human groups hunted and fished, which animals they preferred, how the animals were processed and cooked, and how the resulting waste was discarded. This section outlines some of the methods used by zooarchaeologists to examine the question of site seasonality.

Faunal analysts use historic records and contemporary biological studies of modern animals to reconstruct the seasonal timing of prehistoric exploitation activities. The presence or absence of migratory species, which are only available during certain periods of the year, is particularly useful in determining when hunting and fishing activities occurred at an archaeological site (Davis 1987:76; Monks 1981:180, 181; Pike-Tay 1991:20-22). Season of animal death can also be used for the same purpose, and is usually extrapolated from epiphyseal fusion, dental eruption, and/or bone measurement data collected from the youngest individuals within the population (Davis 1987:76; Monks 1981; Pike-Tay 1991). Researchers assume that within the geographic region of interest, past animals were born at the same time of year and grew and aged at the same rate as their contemporary counterparts (Monks 1981). The study of incrementally deposited tissues, such as mammal dental cementum and dentine, fish bone and scales, and mollusc shell (Davis 1987; Monks 1981; Morey 1983; Pike-Tay 1991), known as skeletochronology (Burke 2000:29; Pike-Tay 2000:2), is also used to approximate the timing of animal death during the year. Given the advancements in our analytical technology during the past three decades, the precision offered by this technique is favoured by many zooarchaeologists.

While all of these approaches help to identify when faunal procurement activities were occurring at a given locale, researchers must also consider the range of human choices that led to each specimen's deposition prior to inferring the season of site occupation (Monks 1981). Mammals, birds, and fish were captured, processed, and often preserved by drying, smoking, or freezing for future use. These resources were then consumed, transported, or traded for other desired items as needed. Such practices can obviously complicate efforts to determine the season in which a particular site was occupied.

Determining Site Seasonality Using Southern Ontario Fauna

Southwestern Ontario, located within the northern limit of the Carolinian forest (Figure 2.1), supports a diversity of faunal and floral species, which together compose several unique biotic communities. These include: temperate broadleaf forests, mixed deciduous and coniferous forests, savannas, prairies, wetlands, and sand dunes (Kavanaugh et al. 1999:164). The area of interest is bordered by three lakeshores and contains three significant river drainages. Animal and plant availability varies on a seasonal basis within this northern temperate region, and likely influenced precontact subsistence and settlement strategies. The faunal species most commonly identified in southern Ontario archaeological assemblages are listed in Appendix B.

Methods of Analysis

During the past two decades, regional studies of precontact faunal procurement strategies (e.g., Smith 1996; Socci 1995; Styles 2000) have slowly begun to appear for northeastern North America. Local site-specific data, representing both short- and long-term occupations, are summarized to examine changes in species exploitation within a region over time resulting from subsistence, settlement, political, and/or social decisions. These studies combine assemblages excavated over several decades and analyzed by a number of zooarchaeologists. They use the most basic unit of quantification, the number of identified specimens (NISP) since, unlike derived measures such as the minimum number of individuals (MNI), NISP is calculated the same way by all

analysts. Researchers conducting such regional studies also group the identified specimens into broader categories to facilitate comparisons among sites.

Given that the Western Basin assemblages examined in this study were excavated over a thirty-year period and derive from the work of multiple analysts, a similar approach was used. The assemblage data are presented here as either NISP counts or as percentages of total NISP.

The highly fragmented nature of the ten selected Western Basin faunal assemblages limited the number of techniques of seasonal determination that could be applied in this study. Age-based methods all rely on the presence of relatively complete elements in order to collect skeletal fusion, dental eruption, and measurement data. Examining incremental structures, for example in teeth, requires that tissues are well preserved so that they can undergo thin sectioning. Site seasonality estimates are therefore primarily derived from taxa abundances in the present analysis.

Historic records and contemporary data on seasonal changes in species ranges and habitat preferences in southern Ontario help to reconstruct the season of Western Basin site occupation. Faunal class abundance, which is plotted in Figure 2.2 for the selected Western Basin assemblages, provides a preliminary indication of site seasonality. In general, within the lower Great Lakes region, a mammal-dominated assemblage suggests a cold season occupation, while a fish-dominated assemblage indicates a warm season one. A combination of mammals and fish implies occupations during both the warm and cold seasons. While many birds can be procured year-round, the presence of reptiles, amphibians, mussels, and snails usually suggests a warm season occupation. These five categories account for only small proportions of the analyzed Western Basin assemblages.

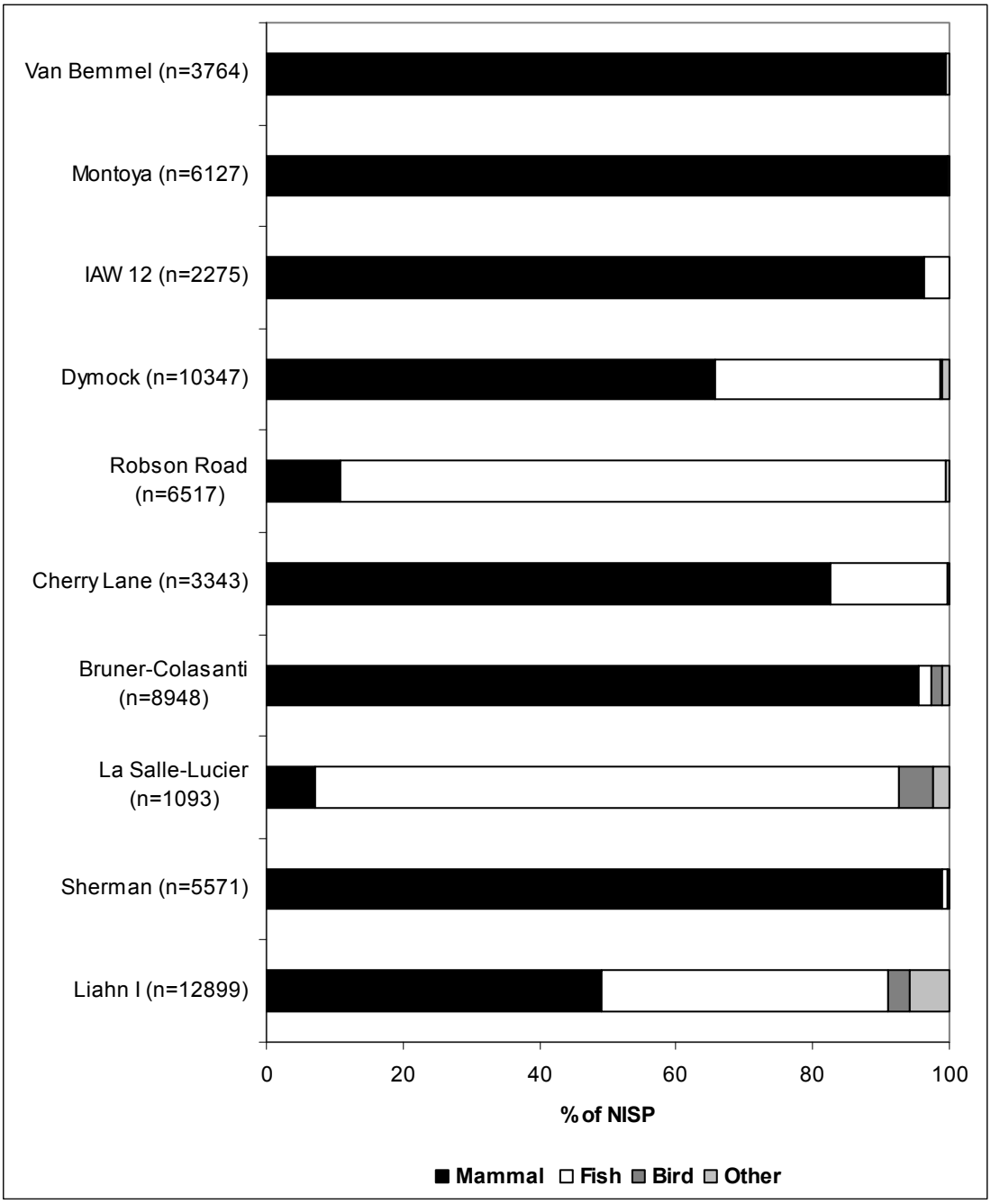


Figure 2.2. Main faunal class representation at selected Western Basin sites. The other category includes reptiles, amphibians, mussels, and snails. IAW 12 = Inland Aggregates West Location 12.

A suite of 18 taxonomic categories (Table 2.1; Figure 2.3) representing all faunal classes is used here to determine the season(s) of occupation at the chosen Western Basin sites. The categories were selected based on their presence in multiple assemblages and/or their potential ability to suggest season of occupation when combined with other categories. Diagrams illustrating the seasonal availability of the categories identified at each site (Appendix C) were constructed in order to pinpoint the most likely period of occupation. In each case, the species are presented in decreasing order of abundance.

By examining season of occupation for 10 southwestern Ontario Western Basin sites, this study identifies the variability in location and timing of faunal exploitation strategies between A.D. 800 and 1400. An emphasis is placed here on taxonomic abundance, rather than simply presence and absence data, to identify the most intensive period(s) of site occupation and the primary faunal procurement foci during that time. Categories with low counts likely reflect supplementary exploitation activities (i.e., these animals do not greatly contribute to the economy, but were most likely hunted, fished, or collected for variety, due to individual preference, etc.) and/or the transport of resources to the site from other areas. Given the variation in their availability and abundance, fish and migratory birds are the most reliable indicators of season of occupation in the lower Great Lakes region. As most mammals and terrestrial birds (Appendix B) can be hunted year-round, their abundances are not extensively used here to derive site seasonality estimates. Exceptions include cervids (deer) and muskrats, whose season of capture at some Western Basin sites is suggested by epiphyseal fusion, and for cervids, antler growth.

Table 2.1. Taxonomic categories used in Western Basin seasonality determinations

Taxonomic Category	Animals Included	Seasonal Availability
Cervid (deer)	white-tailed deer, elk, large cervid, cervid, artiodactyl	spring, summer, fall, winter
Muskrat	muskrat	spring, summer, fall, winter
Percid (perch)	*Sander* sp., walleye, yellow perch, percid	spring, summer, also fall and winter in lakes
Centrarchid (sunfish)	*Lepomis* sp., rock bass, bass, centrarchid	spring, summer, early fall
Freshwater drum	freshwater drum	spring, summer, early fall
Catostomid (sucker)	*Catostomus* sp., *Moxostoma* sp., catostomid	spring, summer, early fall
Esocid (pike)	*Esox* sp.	spring, summer, early fall
Bowfin	bowfin	spring, summer, early fall
Lake sturgeon	lake sturgeon	spring, summer, early fall
Ictalurid (catfish)	stonecat, brown bullhead, channel catfish, ictalurid	spring, summer, fall
Salmonid (salmon)	whitefish, lake herring, *Salvelinus* sp., salmonid	spring, fall, early winter
Burbot	burbot	winter, early spring
Anatid (waterfowl)	swan, Canada goose, lesser snow goose, goose, bufflehead, small duck, small to medium duck, medium duck, medium to large duck, large duck, duck	spring, summer, fall, also a few species in winter
Passenger pigeon	passenger pigeon	spring, summer, fall
Turtle	turtle	spring, summer, early fall
Anuran (frog/toad)	frog/toad	spring, summer, early fall
Mussel	mussel	spring, summer, early fall
Snail	snail	spring, summer, early fall

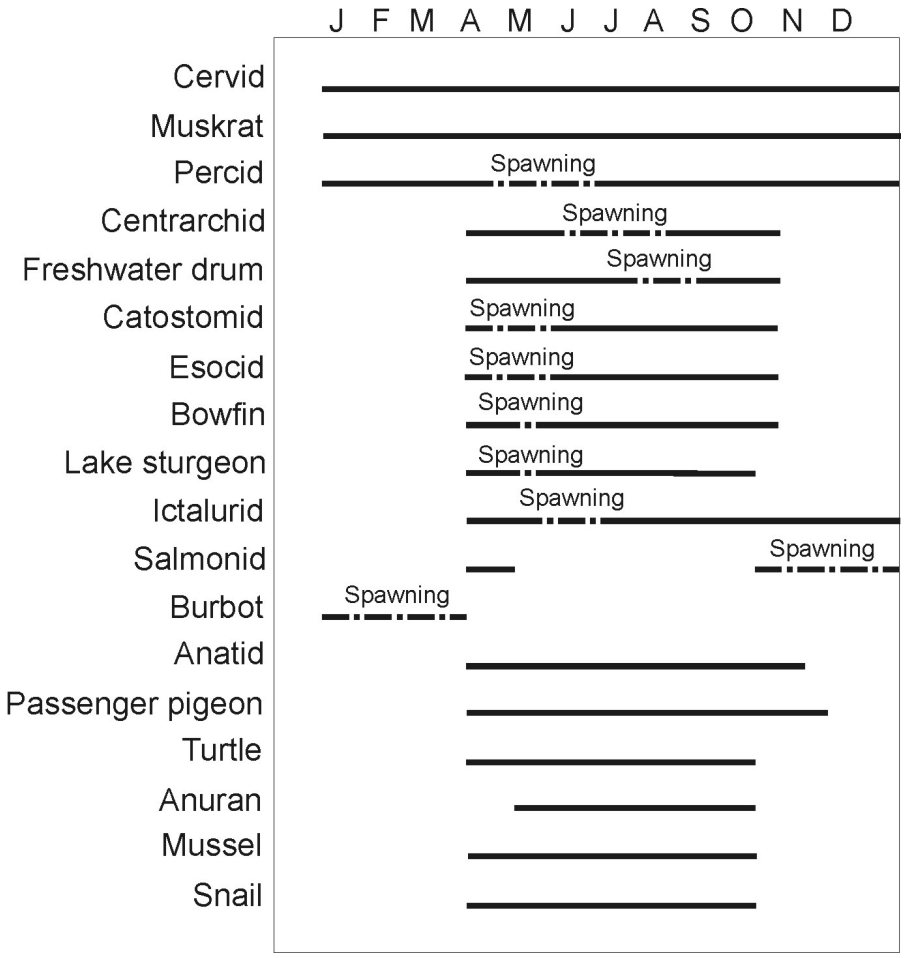


Figure 2.3. Seasonal availability of main southwestern Ontario taxa.

It is difficult to delimit the period and length of time a site was occupied (i.e., weeks, months) solely using the zooarchaeological record. The recovered assemblage could represent short, intensive exploitation events (i.e., fall deer hunt, spring fish run) or an extended period of hunting and fishing (i.e., throughout the fall and winter or throughout the spring and summer). Such ambiguity may potentially be resolved by examining other archaeological evidence. For instance, the presence and abundance of pit features usually indicates longer-term occupations, often, though not always, inhabited during the cold season when stored food resources would have been relied upon for survival. Similarly, the permanence and density of structures suggests the length and intensity of the stay. The labour required for the construction of dwellings and other protective structures (e.g., fences, windbreaks) was likely reserved for

sites that were inhabited for extended periods. These structures would have been a necessity during winter and spring, the coldest and wettest months of the year.

Seasonal Availability of Southwestern Ontario Fauna

Fish are the most reliable indicators of site seasonality in southern Ontario. Availability estimates are based on spawning activities, which are dictated by seasonal changes in water temperature, and their seasonal habitat preferences in the lower Great Lakes region. It is assumed that fish were most intensively procured, likely using combinations of weirs, traps, nets, and spears, when they spawned from the early spring until the late fall in the shallows of southwestern Ontario's lakes and rivers, at which time they were available in greater numbers and easier to catch than when occupying deeper waters. The archaeological record identifies fish as an important prehistoric food, especially during the warm season, and indicates that Western Basin peoples exploited several families. These include: perch-like fishes (order *Perciformes*), suckers (family *Catostomidae*), pikes (family *Esocidae*), bowfin (family *Amiidae*), lake sturgeon (family *Acipenseridae*), catfish (family *Ictaluridae*), lake whitefish and lake trout (family *Salmonidae*), and burbot (family *Gadidae*) (Hubbs and Lagler 1947; Scott and Crossman 1998).

The perch-like fishes, whose families spawn throughout the warm season, are the largest order in the lower Great Lakes region (Scott and Crossman 1998). The early spring spawners, including yellow perch, sauger, and walleye, all members of the perch family (*Percidae*), move in large numbers from the depths of Lakes Huron, St. Clair, and Erie to the shallow rocky shoals of these lakes, large rivers and streams as soon as they are free of ice (Hubbs and Lagler 1947; Scott and Crossman 1998). These three species spawn for a short period between April and early June before returning to the shallow, turbid areas of the lakes, or seeking out ponds and quiet, slow-moving rivers for the remainder of the warm season (Scott and Crossman 1998). They occupy these locations, which are also preferred by other families within this order, including the sunfishes (family *Centrarchidae*) and freshwater drum (family *Sciaenidae*), from

May until September. Sunfishes spawn in these areas between late May and June, while the freshwater drum spawn somewhat later between July and September (Scott and Crossman 1998). All of the perch-like fishes move to the cooler, deeper waters of the lakes in the fall (Scott and Crossman 1998).

The suckers, pikes, bowfin, and lake sturgeon are also early spring spawners (Scott and Crossman 1998). Sucker spawning location and timing is nearly identical to the perch family (Hubbs and Lagler 1947). These fish move upstream from or to shallow areas of Lake Huron, Lake St. Clair, and Lake Erie to spawn and return to the slow moving tributaries and shallow areas of these lakes for the remainder of the warm season (Scott and Crossman 1998). They reoccupy the cool depths of the lakes in the fall for the winter (Scott and Crossman 1998).

The pikes, represented by the northern pike, grass pickerel, and muskellunge, spawn in the heavily vegetated areas of tributary river floodplains, marshes, and the larger, warmer bays of the lower Great Lakes as soon as the ice melts in April and May (Scott and Crossman 1998). Only during the height of the summer do these fish seek out deeper, cooler, lake waters (Hubbs and Lagler 1947; Scott and Crossman 1998). Pikes often return to warm, shallow, vegetated areas in the fall prior to occupying winter depths (Scott and Crossman 1998).

Bowfin and lake sturgeon spawn slightly later, between May and June. Throughout the warm season bowfin inhabit the swampy bays of Lakes Huron, St. Clair, Erie and their associated rivers where they spawn between late April and early June (Scott and Crossman 1998). Lake sturgeons migrate upriver from the lakes as soon as the waterways are free of ice. They spawn from early May to late June, then return to shallow, followed by deep river and lake locations for the remainder of the warm season. Lake sturgeons reoccupy the banks of these rivers and lakes in the fall, prior to moving into deeper water for winter (Scott and Crossman 1998).

The catfish family, represented by channel catfish and the bullheads, spawn in the late spring through to the early summer, generally in May and June

(Scott and Crossman 1998). This timing corresponds with many of the perch-like fishes, and occurs in the vegetated shallows of the lower Great Lakes, their associated rivers and nearby ponds (Scott and Crossman 1998). The bullheads remain in these locales throughout the warm season, while channel catfish seek out cooler, clear deeper waters of lakes and large streams (Hubbs and Lagler 1947; Scott and Crossman 1998).

The fall-spawning lake whitefish, cisco/lake herring, and lake trout are deep-water species occupying the cool bottoms of Lakes Huron, St. Clair, and Erie (Hubbs and Lagler 1947; Scott and Crossman 1998). They aggregate in large numbers along the lakeshores and at the headwaters of tributary streams (Scott and Crossman 1998) to spawn in the fall and early winter, generally between September and December. Lake whitefish and lake trout disperse through the lakes following spawning and may be observed near the surface after ice break-up before they retreat to greater depths for the warm summer months (Scott and Crossman 1998).

The cod family is the last considered here, and is represented by a single species, burbot. This fish is especially important for determining season of site occupation as it spawns under the ice in the middle of winter (Hubbs and Lagler 1947; Scott and Crossman 1998). Burbot usually occupy the cold deep waters of the Great Lakes, and are only found in shallow lakeshore, bay, and river environments between January and March when they spawn (Scott and Crossman 1998). This species may move to streams and rivers during late winter and early spring post-spawn (Scott and Crossman 1998), where it may be procured with early spring spawning fish.

While fish provide fine-grained information about season of site occupation, the presence and overall abundance of certain mammals and birds can also help to identify period and length of settlement. At certain times of the year some mammals are easier to hunt, trap, or snare as they are more or less active or aggregate together in large numbers. Both white-tailed deer and elk prefer open forest and meadow environments, which they move between throughout the year (Kurta 1995:263, 264, 266; Reid 2006:491). Rutting and

mating occur in the fall, usually between September and October for elk and November or December for white-tailed deer, with calves/fawns born in May or June (Kurta 1995:263, 266; Reid 2006:491, 495). Not surprisingly, both prehistoric and historic hunters took advantage of the abundance and year-round availability of these large mammals.

Muskrat den in wetland environments, often along riverbanks, and are also hunted throughout the year (Reid 2006:326, 327). These aquatic rodents are most active during the warm season, especially in the spring when damage from melt water causes them to reinforce and/or repair their homes. Muskrat breeding takes place primarily following ice break up in the spring, from March until May, and females frequently have up to three litters within a season (Kurta 1995:178). Although the young are generally born in the spring, some litters arrive as late as October (Kurta 1995:177).

Migratory birds are also excellent seasonal indicators given their limited availability within the region. Unfortunately, bird remains were not well preserved in the examined Western Basin assemblages, and as such provide very little insight into the timing of site occupation. The most useful species, however, are passenger pigeon and waterfowl (family *Anatidae*). Passenger pigeons, now extinct, migrated to the forests of southwestern Ontario between March and May, where they nested, roosted, and fed throughout the warm season (Mitchell 1935). These birds returned south to warmer climates when food became scarce during the late fall, usually between late September and November (Mitchell 1935).

The various swan, goose, and duck species that pass through and/or inhabit southwestern Ontario between late-March and mid-November have been extensively studied over the past century (Sandilands 2005). These birds prefer the bays and shallows of Lakes Huron, St. Clair, and Erie, especially the sand dune communities of Point Pelee, Pointe aux Pins, and Long Point along Lake Erie's northern shore. They also frequent the rivers, ponds, and swamps within these drainage systems throughout the warm season. Most, however, return to more southerly locales for the coldest months of the year (Sandilands 2005).

Frogs, toads, and turtles inhabit a variety of terrestrial and aquatic environments. Frogs and turtles favour wetlands, particularly ponds, swamps, marshes, bogs, rivers, streams, and lakes (Conant and Collins 1998; Harding 1997), while toads and tree and wood frogs prefer more terrestrial habitats, including open woodlands, forest edges, prairies, and meadows (Conant and Collins 1998; Harding 1997). Most turtles of the lower Great Lakes region hibernate in shallow water, muskrat tunnels, or under plant debris close to water during the coldest months of the year, generally October to April (Harding 1997). Toads and wood frogs burrow deep into the soil to winter and remain dormant until conditions improve in the spring (Harding 1997:117, 152), while frogs bury themselves in mud and debris at the bottom of ponds, swamps, and marshes to hibernate between October and May (Harding 1997). Given their seasonal dormancy, amphibians and reptiles are easiest to hunt/collect from the spring until the fall. This is the same period during which mussels and snails are most available for collection in the aquatic, forest, and prairie habitats of the lower Great Lakes region.

Interpreting Western Basin Site Seasonality

Research on Western Basin peoples only began during the second quarter of the twentieth century. E.F. Greenman (1937, 1939) first recognized them as the creators of a distinct late precontact material record during his excavations of the type Riviere au Vase, Younge, and Wolf sites in Michigan. Additional investigations over the next 50 years (e.g., Fitting 1965; Murphy and Ferris 1990; Stothers and Abel 2002; Stothers and Bechtel 2000; Stothers et al. 1984, 1994) limited Western Basin presence to the southern Lake Huron, Lake St. Clair, and western Lake Erie drainage basins of southeastern Michigan, northwestern Ohio, and southwestern Ontario.

The Western Basin Tradition Late Woodland occupation in southern Ontario dates between A.D. 650 and 1600, and is divided into four phases, Riviere au Vase, Younge, Springwells, and Wolf, based on ceramic vessel

construction and decorative attributes[1] (Murphy and Ferris 1990). This study examines the best-documented period (A.D. 800-1400) of Western Basin occupation, roughly corresponding to the Younge and Springwells phases, to illustrate how the zooarchaeological record can contribute to our understanding of seasonal patterns of mobility.

Two competing Western Basin subsistence and settlement models have been presented to date. Considering only the Ontario data, Murphy and Ferris (1990:231) suggested that Western Basin groups inhabiting the ecologically rich and diverse southwestern region practiced a seasonally mobile subsistence and settlement pattern that was initially developed by their Middle Woodland predecessors. Annual mobility and group coalescence and dispersal patterns were based on the seasonal availability and abundance of preferred plant and animal resources at known extraction locales. During the late fall and winter, small family groups generally situated themselves in the interior of the region, often within secondary drainages, where they hunted and processed white-tailed deer and other mammals. In the spring, many families came together to harvest spawning runs of fish at the lakeshores and near the rapids and mouths of the major rivers. They then moved along the rivers to establish their warm season base camps. These camps would have served as fixed locales for the duration of the spring and summer, where people would have harvested and processed both local and distant resources, including terrestrial and aquatic animals, berries and nuts, and perhaps even small quantities of maize. Food gathering during this period was informal and flexible, and emphasized the collection of plants and animals for both immediate and future needs.

While Stothers and colleagues' (see Bechtel and Stothers 1993; Stothers et al. 1984, 1994; Stothers and Abel 2002) agree, for the most part, with the Murphy and Ferris (1990) model, their examination of additional data from Michigan and Ohio indicated that maize was an important dietary component for many Western Basin groups from the Riviere au Vase phase onwards. As such,

[1] The reader is referred to Murphy and Ferris (1990:195-230) for descriptions of common vessel types and a discussion of the development of the current ceramic typology.

the growing of this, and other domestic crops, figured more prominently in their interpretation of Western Basin subsistence and settlement approaches. These researchers (see Stothers et al. 1994:161, 164; Stothers and Abel 2002:89) further suggested that, over time, warm season settlements shifted from river mouths and lakeshores to interior, upriver locations where both intensive fish harvesting and farming could successfully occur. Stothers et al. (1994:158) also recognized that, given the different environments inhabited and the fluctuations in local resource availability, cold season subsistence strategies likely varied from one group to another and from location to location throughout the entire region of Western Basin occupation.

Most transitional Riviere to Younge and early Younge phase settlements investigated in Ontario are small in size, with few well-documented palisade and dwelling structures. They are characterized instead by the presence of numerous large, often overlapping pit features that were primarily used as cold cellars to cache food (Murphy and Ferris 1990:236). During the latter part of the Younge phase and into the Springwells phase, Western Basin peoples continued to disperse into small family groups for winter hunting activities in the interior. However, there is some suggestion of warm season site expansion, with greater evidence of palisades and multiple dwelling structures compared to earlier sites. Many of these late spring through fall settlements appear to be situated near a variety of microenvironments, which suggested to Murphy and Ferris (1990:244) that maize and other domesticates increased in dietary importance during the Springwells phase. Specifically, this shift in warm weather site location reflected a preference for placing settlements in areas where crops could easily be grown and tended while also allowing inhabitants to conduct fishing, hunting, and collecting activities nearby.

Zooarchaeological data compiled from 10 sites (Figure 2.1) are used here to assess Murphy and Ferris' (1990) model of the seasonal subsistence strategies and annual movements of southwestern Ontario's Younge and Springwells groups. Faunal assemblages are analyzed to provide a more nuanced understanding of when hunting and fishing activities were scheduled

throughout the year and to identify the variety of locations where these activities occurred. The chosen assemblages are listed in Table 2.2. Most sites were inhabited more than once and seven display occupation during two or more temporal phases. The salvage and mitigative nature of the archaeological excavations in these areas generally did not permit the recognition and careful excavation of each settlement event. As such, all identified faunal remains were pooled for the multi-phase Montoya, Robson Road, Bruner-Colasanti, La Salle-Lucier, and Liahn I sites. This approach should not significantly influence the results of this study as the emphasis is on documenting seasonal subsistence and settlement patterns during the 600 years of interest, rather than between the temporal phases included in this period. It should be noted that the researchers who excavated these five sites (Archaeologix Inc. 2004; Kenyon 1988; Kenyon et al. 1988; Lennox 1982; Lennox and Dodd 1991) did not identify significant differences in the faunal remains recovered from phase-specific features (represented by sealed, short-term deposits associated with temporally diagnostic ceramics). For the purposes of the present study, the faunal assemblages recovered from these sites are considered reflective of the locale itself.

The majority of the faunal material was recovered from pit features ranging in size from 40 to 300 cm in diameter and 10 to 100 cm in depth (Archaeologix Inc. 2004; Ferris and Mayer 1990; Fox 1982; Kenyon 1988; Kenyon et al. 1988; Lennox 1982; Lennox and Dodd 1991; Murphy 1991; Murphy and Ferris 1990). These assemblages are extremely fragmented, with the majority of specimens measuring between 0 and 50 mm in maximum dimension. Dry screening and flotation of the subsoil and feature fill recovered all major faunal classes (Figure 2.2). However, the high rate of fragmentation and the friability of the specimens resulted in the assignment of large proportions of the assemblages to either generalized faunal classes or to an indeterminate category. Only specimens identified to class or lower taxon are included in this discussion of Western Basin seasonal subsistence activities between A.D. 800 and 1400.

Table 2.2. Analyzed Younge and Springwells faunal assemblages

Site	Phase	Date(s)	Analyst	Size (n)	References
Van Bemmel (AcHm-31)	R-Y	840±70 A.D. uncal[1]	Rosemary Prevec	**3764**	Ferris 1989; Prevec 1988a
Montoya (AfHi-243)	R-Y	ca. 800-1000 A.D.[2]	Foreman, this study	**6127**	Archaeologix Inc. 2004
IAW 12 (AgHk-60)	Y	1100±30 A.D. uncal[1]	Foreman, this study	**2275**	Archaeologix Inc. 2008
Dymock (AeHj-2)	Y	920±80 A.D. to 1100±80 A.D. uncal[1]	Rosemary Prevec	**10347**	Fox 1982; Prevec 1981
Robson Road (AaHp-20)	R-Y-S	900±80 A.D.to 1350±70 A.D. uncal[1]	Rosemary Prevec	**6517**	Kenyon et al. 1988; Prevec 1988b
Cherry Lane (AaHp-21)	Y-S	1000±70 A.D. to 1180±70 A.D. uncal[1]	Rosemary Prevec	**3343**	Ferris and Mayer 1990; Prevec 1989
Bruner-Colasanti (AaHq-8)	Y-S	1070±75 A.D. to 1235±75 A.D. uncal[1]	Beverly Smith	**8948**	Lennox 1982
La Salle-Lucier (AbHs-8)	Y-S	ca. 1100-1200 A.D.[2]	Christine Dodd	**1093**	Lennox and Dodd 1991
Sherman (AdHl-16)	S	1240±70 A.D. to 1370±70 A.D. uncal[1]	Rosemary Prevec	**5571**	Murphy 1991
Liahn I (AcHo-1)	S-W	1320±30 A.D. to 1550±60 A.D. uncal[1]	Foreman, this study	**12899**	Kenyon 1988

Note: Specimens identified to class are reported. All assemblages were screened through 6 mm mesh with samples collected for flotation. Fauna recovered in the Montoya and Inland Aggregates West Location 12 site flotation samples were unavailable for analysis. R = Riviere au Vase, Y = Younge, S = Springwells, W = Wolf phases of Western Basin occupation. [1]Uncalibrated radiocarbon years A.D., [2]Date based on pottery attributes.

Results

The abundances of the chosen seasonal indicator categories are examined here for each site. Together these data suggest the faunal procurement foci of Younge and Springwells phase peoples in these locales and

indicate when during the year these activities were conducted. The reader is again referred to Figure 2.1, which illustrates the location of each site in southwestern Ontario, to Table 2.3 for a summary of the indicator taxa and their abundances at each site, and to Appendix C, which illustrates the seasonal availability of the identified taxa by site.

Van Bemmel

Van Bemmel, a small transitional Riviere au Vase to Younge phase settlement occupied between A.D. 750 and 900, is located on a sandy-loam ridge overlooking McGregor's Creek, just south of the Thames River near Chatham (Ferris 1989:5). Post moulds, hearths, and pits were identified in the 40 m by 15 m area of excavation, within which a single row palisade was discerned along the northern-most edge of the site. Ceramic and lithic artifacts, bone, and ash were recovered in large quantities from a greasy black layer at the topsoil-subsoil interface (Ferris 1989:8). Based on the abundance of projectile points, scrapers, and white-tailed deer remains, the presence of carbonized walnut shell, and the absence of large storage pits, Ferris (1989) suggested that Van Bemmel represented a short-term late fall hunting and processing camp that was visited several times between A.D. 800 and 900.

While the number and length of the occupations cannot be verified by the faunal dataset, the season of most intensive activity can. The abundance of cervid remains (and the presence of other mammal species such as raccoon, eastern gray squirrel, muskrat, and river otter; Appendix A: Table II) and the low prevalence of fish and other warm season indicators (i.e., migratory birds, reptiles, amphibians, mussels, and snails) observed in Table 2.3, suggests that hunting was the primary focus at this locale, and that it likely occurred during the fall and/or winter. This interpretation may be supported by the presence of a palisade structure at the site, which would have helped to protect the inhabitants from unpredictable weather conditions during the cold season.

Table 2.3. Indicator taxa abundances (% of total number of indicator taxa) at selected Western Basin sites

Category	Van Bemmel (n=282)	Montoya (n=587)	IAW 12 (n=321)	Dymock (n=3697)	Robson Road (n=1483)
Cervid	91.13	98.30	95.95	15.20	26.57
Muskrat	2.48	0.17	-	-	0.20
Percid	-	-	-	25.80	34.32
Centrarchid	-	-	1.87	0.22	3.78
Freshwater drum	-	-	-	-	5.06
Catostomid	0.35	-	1.56	55.34	10.59
Esocid	-	-	-	-	-
Bowfin	-	-	-	-	0.27
Lake sturgeon	-	-	-	-	0.61
Ictalurid	-	-	-	0.73	1.75
Salmonid	-	-	-	-	0.13
Burbot	-	-	-	-	14.90
Anatid	-	-	-	-	-
Passenger pigeon	-	0.17	-	0.05	0.07
Turtle	1.77	0.68	-	0.76	0.88
Anuran	-	-	-	0.35	0.40
Mussel	4.26	0.51	0.62	1.54	0.47
Snail	-	0.17	-	-	-

Category	Cherry Lane (n=136)	Bruner-Colasanti (n=839)	La Salle-Lucier (n=62)	Sherman (n=344)	Liahn I (n=3153)
Cervid	13.97	86.53	12.90	92.15	19.06
Muskrat	-	0.95	4.84	-	28.54
Percid	5.15	1.31	14.52	0.29	1.74
Centrarchid	0.74	0.36	6.45	-	2.98
Freshwater drum	5.15	0.12	14.52	-	0.48
Catostomid	-	0.12	1.61	5.81	0.03
Esocid	-	-	-	-	0.76
Bowfin	-	-	27.42	-	15.98
Lake sturgeon	-	0.12	-	-	-
Ictalurid	3.68	-	9.68	-	3.58
Salmonid	36.03	-	-	-	-
Burbot	29.41	-	-	-	-
Anatid	-	0.60	-	-	3.27
Passenger pigeon	-	-	-	-	-
Turtle	-	-	1.61	0.29	1.81
Anuran	0.74	1.79	-	-	-
Mussel	5.15	2.86	-	1.45	5.90
Snail	-	5.24	6.45	-	15.86

The abundance and availability of the recovered indicator taxa could support Ferris' (1989) interpretation, but the possibility of multiple occupations varying in length throughout the fall and winter cannot be confidently ruled out. As such, it is suggested here that Ferris' (1989) seasonality estimate should be

expanded to include the coldest months of the year, placing Riviere and Younge phase peoples at Van Bemmel some time between October and February. As will become evident in the following sections, if Western Basin peoples were in the area to any extent during the spring and/or summer, evidence of fishing and the hunting/collecting of other aquatic resources would have been much more apparent at Van Bemmel.

Montoya

The Montoya site, a Riviere to Younge phase settlement likely occupied between A.D. 800 and 1000, is located in a sandy locale overlooking the floodplain of Trout Creek near Strathroy (Archaeologix Inc. 2004). An area of approximately 150 m by 90 m in the eastern portion of the site was excavated prior to subdivision development. Numerous post moulds, hearths, pits, and a midden were recorded, and while no complete house structures were delimited, several wall sections were identified, implying a complex settlement pattern (Archaeologix Inc. 2004:33, 41). Large quantities of lithic tools, including bifaces, projectile points, scrapers, and drills, ceramic vessel and pipe fragments, and faunal remains were recovered from the site.

Based on the abundance of faunal remains and the tool kit recovered, the investigators suggested that hunting was the main subsistence activity (Archaeologix Inc. 2004:33). The identification of several other components in the vicinity dating to the same period led to the hypothesis that the site may represent seasonal re-use of the area by Riviere and Younge phase peoples rather than a single village occupation (Archaeologix Inc. 2004:33, 41). A focus on hunting is supported by the high prevalence of cervid remains identified in the assemblage (Table 2.3). The timing of these activities, however, may only be inferred by examining the abundances of other animal categories at Montoya.

The absence of fish remains and the low prevalence of migratory birds, reptiles, mussels, and snails, which are primarily available during the spring and summer, suggest that Riviere and Younge phase peoples did not intensively inhabit this locale during the warm season. Considered together, the current archaeological evidence, including the abundant pit features and complex

settlement pattern, indicate that Montoya was most likely occupied during the cold season, probably between October and February, for cervid hunting. Other locally available mammals [e.g., raccoon, eastern chipmunk, black bear, muskrat, mustelid (e.g., river otter, mink, marten, weasel), woodchuck] were also procured at this time (Appendix A: Table II).

Inland Aggregates West Location 12

Inland Aggregates West Location 12, a Younge phase settlement occupied between A.D. 1050 and 1150, is located in a sandy area approximately 2 km south of the Ausable River near Arkona. Archaeologix Inc. (2008) excavated the site in the summer of 2007 prior to the commencement of aggregate mining. Only the western two-thirds, which encompasses a 50 m by 45 m area, was excavated; the eastern portion, located in a previously licensed aggregate pit was inaccessible (Archaeologix Inc. 2008:5). During the field season 21 features were identified, cross-sectioned, and excavated, as was a semi-circular row of posts that either represents a partial palisade or fence (Archaeologix Inc. 2008:21). Analysis of the excavation data is ongoing and interpretations of site use and season of occupation have yet to be presented.

As part of this study, faunal specimens recovered from two of the 21 features were analyzed, Feature 14 located within the palisade or fence, and Feature 19 located outside of it. Table 2.3 demonstrates that only four indicator taxa were identified in the sample. The abundance of cervid and unidentifiable large mammal specimens suggests an emphasis on white-tailed deer hunting and processing at this locale.

Although the archaeological record indicates that the site was intensively occupied, the season of settlement remains somewhat ambiguous. It would be easy to suggest based on the cervid, pit feature, and settlement data that like Van Bemmel and Montoya, Inland Aggregates West 12 was primarily occupied during the cold season. However, the recovery of sunfish, sucker, and mussel specimens indicates that individuals were either at this locale some time between the spring and fall when these animals could easily be procured in the Ausable and Sydenham River drainages, or that instead, they were procured in another

area during the warm season and brought to the site at the time of occupation. Analysis of the remainder of the faunal assemblage and the recovered floral remains should help to determine whether Younge phase peoples also inhabited Inland Aggregates West Location 12 during the warm season.

Dymock

The Dymock site, likely occupied between A.D. 850 and 1200, consists of two separate Younge phase settlements located on successive sandy terraces of the Thames River near Glencoe (Cooper 1982:3). The northern component, identified as Dymock I, is represented by an area approximately 11 m by 33 m within which a partial palisade, several post moulds, a hearth, numerous pits, and a hillside midden were identified (Fox 1982:3). Dymock II, the southern terrace, encompassing an area approximately 15 m by 38 m, contained a portion of a palisade, post moulds outlining a possible house end, multiple hearths, pits, and human and dog burials (Fox 1982:5, 7). Based on similarities in size and spacing of the Dymock site post moulds to those identified at the Cherry Lane site, Murphy and Ferris (1990:242) re-interpreted Fox's palisades as portions of house walls. Given the abundance of spring spawning sucker and sauger/walleye, white-tailed deer, butternut, and maize remains, Fox (1982) suggested a spring and fall occupation of the site. Prevec's (1981) faunal analysis supports this interpretation. Sucker and walleye/sauger dominate the assemblage, indicating occupation of the site from the spring to the early summer (i.e., April to July) when these fish travel up the Thames River to spawn. A late winter to spring occupation is suggested by the recovery of foetal/newborn fawn remains and new antler growth on a cervid skull (Prevec 1981:34). This period may be extended through the summer and fall based on the presence of immature great blue heron and mammal bones, turtles, and passenger pigeon (Prevec 1981:34) as well as a variety of grass seeds, sumac, and raspberry/blackberry (Cooper 1982).

The abundances of the indicator categories identified at this locale (Table 2.3) confirm these seasonal determinations. Further warm season occupation is suggested by the recovery of mussel, catfish, frog/toad and sunfish specimens.

These species place people at Dymock between April and November. Cervid remains dominate the mammal assemblage, and while Prevec's (1981) identification of newborn fawn remains indicates deer hunting in the spring, it also likely occurred throughout the summer, fall, and winter. Cervids, small to medium mammals, and terrestrial birds (Appendix A: Tables II and IV) were probably hunted in the forests surrounding the site, in areas of higher concentrations of nut-bearing trees.

The variety of species exploited at Dymock suggests an intensive occupation, a supposition that is further supported by the presence of dwelling structures, storage pits, and several human and *Canis* sp. burials (Fox 1982). The site was located in an area where locally available fauna and flora could be exploited throughout the year. Between March and June, faunal exploitation efforts were devoted to fishing early spawners and hunting mammals, primarily cervids. The site was probably visited intermittently throughout the summer and fall during which hunting and fishing activities continued. The low percentages of warm season indicators, including mussels, turtles, catfish, amphibians, sunfish, and passenger pigeon (Table 2.3), indicate that faunal procurement was focused elsewhere between July and October. This interpretation supports Murphy and Ferris' (1990:242) suggestion that Dymock might have functioned as a warm weather base camp, initially occupied in the spring for fishing and the planting of domestic crops, visited periodically throughout the summer, and re-inhabited during the late summer or early fall to harvest the crops and hunt.

The possibility that the site was occupied during part or all of the winter must also be considered. The occupants clearly would have cached enough resources (e.g., nuts, maize) to ensure their survival during the cold season, and could have supplemented this stored food with fresh terrestrial mammal meat, marrow, and grease.

Robson Road

The Robson Road site, with its Middle Woodland to Springwells phase components (likely occupied by Western Basin peoples between A.D. 800 and 1400), is located on a large sand hill west of the mouth of Leamington Creek and

overlooking Pigeon Bay (in Lake Erie) just west of Point Pelee (Kenyon et al. 1988:3). Two areas of occupation were identified during the excavation of a 118 m by 62 m area, that together revealed 145 pit features with low artifact densities overall (Kenyon et al. 1988:5-9).

Kenyon et al. (1988:21) examined the fauna in these large, overlapping pits in order to decipher season(s) of site occupation. Based on the presence of lake sturgeon, bowfin, sucker, burbot, yellow perch, sauger/walleye, and white bass they were able to suggest a spring occupation, while turtles, sunfish, freshwater drum, catfish, and passenger pigeon supported spring to summer activities at this locale (Kenyon et al. 1988:21; Prevec 1988b:2, 5). Further, a winter to early spring occupation was indicated by a white-tailed deer skull lacking any evidence of antler re-growth (Prevec 1988b:4).

The number and variety of species exploited at Robson Road implies intensive and repeated occupation of this locale by Western Basin peoples over many centuries (Kenyon et al. 1988:21,22; Prevec 1988b:7). Kenyon et al. (1988) and Prevec (1988b) suggested occupation primarily during the warmer months based on faunal species representation, with occasional cold season use. To summarize, from April to July, the site was a warm season fishing station during which spring and summer spawning fish were procured from either Leamington Creek or Lake Erie (Table 2.3). Locally available mammals, turtles, mussels, frogs/toads, and migratory birds likely supplemented the diet at this time. There is also evidence that Robson Road functioned as a cold season mammal hunting, processing, and fishing station between October and March. Importantly, the fauna demonstrate winter lakeshore fishing of burbot, an activity that was overlooked by previous investigators. Considered together, these indicators suggest not a primarily warm weather occupation as noted by Kenyon et al. (1988), but rather repeated short-term visits throughout the year to procure seasonally abundant resources. It was an important fishing station in the spring and winter. Although fishing likely also took place during the summer, the paucity of reptile, amphibian, mussel, and waterfowl specimens implies that exploitation activities were not concentrated in the area at this time (Prevec 1988b:8).

Mammals would also be better represented (Appendix A: Table II) if the site had been extensively occupied during the cold season. It is very likely that dwelling structures were constructed to protect both the people and the resources they harvested during the spring, fall and winter, and that some of the rendered products may have been stored in the many pits identified at the site.

Cherry Lane

Cherry Lane, with both Younge and Springwells phase settlements, occupied between A.D. 950 and 1250, is located within a one-hectare area encompassing two sandy knolls and the low saddle between them, near Leamington Creek in Leamington (Ferris and Mayer 1990:1). Post moulds, storage, and ash pits were excavated across the site; however, the saddle was interpreted as the main area of occupation based on the identification of a 7 m by 13 m dwelling structure and nearby midden (Ferris and Mayer 1990:7, 8). Considered together, the high number and concentration of pit features, the identification of a house with multiple hearths and interior pits, the recovery of large quantities of chestnut, black walnut, and butternut as well as calcined mammal remains, and large quantities of burbot, lake whitefish, and cisco/lake herring, led Ferris and Mayer (1990:8, 30, 32, 35) to suggest a fall occupation for Cherry Lane.

The abundances of the 9 identified indicator taxa (Table 2.3) support Ferris and Mayer's (1990) cold season interpretation, and extend the proposed fall occupation into the winter. As noted by Ferris and Mayer (1990), lake dwelling, fall spawning salmonids and winter spawning burbot are well represented in the fish component. They are complemented by the identification of small to large mammals (e.g., eastern gray squirrel, chipmunk, raccoon, cervids; Appendix A: Table II) and wild turkey (Appendix A: Table IV). Further, given that the majority of the faunal assemblage was highly fragmented and calcined, it is likely that once these animals had been processed, their bones were burned either as a means of waste disposal or possibly as fuel.

Faunal procurement activities at the Cherry Lane site were clearly focused on hunting terrestrial animals and fishing cold season spawners in the fall and

winter, likely between October and February. While percids could have been caught in Lake Erie at any time of the year, the limited recovery of freshwater drum, catfish, sunfish, mussel, and amphibian remains from the site implies a limited warm season occupation, probably in the early fall, spring, or summer when other subsistence-related activities were taking place nearby. Alternatively, these resources could have been transported to Cherry Lane from elsewhere when it was occupied in the fall. The low percentages (Table 2.3) of these predominantly warm season species, and the absence of migratory bird and reptile remains suggests that the site was not extensively occupied during the spring and summer.

Bruner-Colasanti

Located on a well-drained sand and gravel ridge approximately 4 km north of the Lake Erie shore in the Township of Gosfield South, Essex County, the one-hectare Bruner-Colasanti site was likely inhabited by Younge and Springwells phase peoples between A.D. 1000 and 1300 (Lennox 1982: ii, 3). Over 300 pit and hearth features and a number of post moulds were investigated in the 0.81-hectare excavated area (Lennox 1982:9). Ceramic vessel and pipe fragments, lithic tools, floral, and faunal remains were recovered from features distributed across the site. The presence of numerous large pits with abundant hickory, acorn, and black walnut shell as well as extremely fragmented and burned white-tailed deer and small to large mammal remains (e.g., eastern gray squirrel, black bear, raccoon, mustelid, muskrat, eastern chipmunk, woodchuck; Appendix A: Table II) led Lennox (1982) to suggest a late fall to early spring occupation of Bruner-Colasanti, likely between October and March (Smith 1981 in Lennox 1982:73).

The mammalian evidence for cold season occupation noted by Lennox (1982) is supported by the bird and fish presence/absence and abundance data (Table 2.3). Wild turkey and ruffed grouse (Appendix A: Table IV) were probably procured in fall or winter. The presence of lesser snow goose (which inhabits the area during its fall migration), bufflehead duck (which overwinters in the region), and a yearling black bear, which was likely captured some time between

February and early April (Smith 1981 in Lennox 1982:73, 74), further confirm this settlement period.

The limited number of fish, mussels, and amphibian specimens identified in the assemblage, and the absence of turtles and subadult animals (Smith 1981 in Lennox 1982:75) suggests that Bruner-Colasanti was generally abandoned during the warmest months of the year. These animals, in addition to snails, may have been exploited in the fall or spring to supplement the mammal and terrestrial bird hunting, or they may have been brought to the site when it was occupied in the fall. Together the zooarchaeological, settlement, pit feature, and floral data suggest that Bruner-Colasanti was most intensively occupied between October and March, during which time the inhabitants emphasized hunting of locally available species.

La Salle-Lucier

Younge and Springwells peoples also inhabited the La Salle-Lucier site, a sandy area adjacent to the Detroit River, just south of Windsor in the town of La Salle, between A.D. 1100 and 1200 (Lennox and Dodd 1991:17, 19). Two horizontally distinct habitation areas, one Younge and one Springwells, were identified in the 84 m by 19 m excavated portion of the site. The Younge component consisted of two east-west oriented rows of post moulds with 13 associated large, circular pit features, while a possible palisade, several portions of hypothesized house walls, and 34 features were uncovered in the Springwells component (Lennox and Dodd 1991:19, 22, 31). Very little cultural material was identified in the Younge phase pits. However, ceramic and animal refuse, ash, lithic debitage, fire-cracked rock, and human bundle burials were recovered from the Springwells features (Lennox and Dodd 1991:34). Based on the abundance of summer spawning fish, the presence of turtles, and the recovery of black walnut and hickory shell, Lennox and Dodd (1991:43, 44) suggested a warm season occupation of the locale, likely from the late spring to summer.

Despite the rather small assemblage size (n=1093), 10 indicator categories, over half of which are fish (Table 2.3), were identified in the assemblage. A warm season occupation is supported by the presence of bowfin,

percid, freshwater drum, catfish, sunfish, sucker, snail, and turtle specimens. These species suggest occupation of La Salle-Lucier some time between April and October. The paucity of mammal specimens in the assemblage (Appendix A: Table II) implies that the site was not extensively occupied during the winter. Hunting of locally available mammals, including cervids and muskrat, complemented fishing throughout the spring and summer.

The settlement data suggest extended periods of occupation at La Salle-Lucier. The fauna indicate that Younge and Springwells people primarily inhabited this area from the spring until the fall, expanding Lennox and Dodd's (1991) determination slightly in both directions. However, they are unable to pinpoint when the site was most intensively occupied. As such, a broad seasonality estimate spanning the entire warm season (i.e., April to October) is suggested for La Salle-Lucier.

Sherman

Sherman, located on a sand knoll just east of a small creek and 2 km north of the Thames River near Thamesville, is a Springwells site occupied between A.D. 1200 and 1400. An oval 5 m by 7 m house with 14 associated pits, two hearths, and several post moulds was uncovered in the 19 m by 14 m excavation area (Murphy 1991:4, 5). An abundance of ceramics, lithic debitage, fire-cracked rock, floral, and faunal refuse was collected from the features at the site. Based on the recovery of large quantities of black walnut shell and the fragmented and burned nature of the faunal assemblage, from which only a handful of species were identified, Murphy (1991) interpreted Sherman as a short-term winter settlement.

Five seasonal indicator categories (Table 2.3) are represented in the assemblage. Cervid remains prevail and are complemented by a handful of fish, mussel, and turtle specimens. The paucity of the latter three categories and the absence of migratory birds, amphibians, and snails, suggests that Sherman was not intensively inhabited during the warm season. The sucker, percid, mussel, and turtle specimens identified in the assemblage were either procured at the

nearby creek or the Thames River in the fall or early spring, or may have been brought to the site from elsewhere.

When considered in light of the identified dwelling structure, storage pit, and nut remains, the faunal remains, which also include several small to medium mammals and wild turkey (Appendix A: Tables II and IV) support Murphy's (1991) interpretation of cold season use. Unfortunately the zooarchaeological assemblage is unable to delimit the length or timing of the Sherman site occupation. It most likely occurred some time between October and March, a period that agrees with the estimate put forth by Murphy (1991:15) based on historic Central Algonquian settlement data.

Liahn I

The Liahn I site, a Springwells to Wolf phase settlement likely inhabited between A.D. 1300 and 1600, is located on a low sand ridge adjacent to Rankin Creek, 2 km east of Lake St. Clair in East Dover Township (Kenyon 1988:2). A 24 m by 7 m dwelling structure with associated post moulds, smudge, and storage pits, was uncovered in the 1.6 ha site area (Kenyon 1988:5). Recovered artifacts included chipped and ground stone tools, ceramic pipes and vessels, and an abundance of faunal remains. Kenyon (1988:20) suggested that Western Basin peoples most intensively occupied Liahn I in the summer and early fall and that exploitation strategies were lake-oriented. His assessment was based on the abundance of bowfin, sunfish, catfish, pike, freshwater drum, muskrat, white-tailed deer, raccoon, waterfowl, turtles, and snakes, and the corresponding paucity of early spring spawning species such as lake sturgeon, walleye/sauger, and suckers.

The diversity of fauna exploited indicates extensive use of this locale by Western Basin peoples. A total of 13 indicator categories (Table 2.3) were identified at Liahn I. Mammals and fish contribute nearly equally to the assemblage composition, suggesting occupation during both the warm and cold seasons. An April to October settlement is indicated by the presence of bowfin, snails, mussels, catfish, waterfowl, sunfish, turtles, perches, pikes, freshwater drum, and suckers. These species were probably fished and collected along

Rankin Creek and/or at nearby Lake St. Clair. The remaining animals, represented by muskrats and cervids could have been obtained throughout the year from the diverse wetland and terrestrial habitats surrounding the site (Kenyon 1988:3, 5).

A large proportion of subadult muskrat remains were recovered at Liahn I. Thomas (1988) encountered a similar situation at the nearby late Archaic Crawford Knoll site (AdHo-5). By examining long bone fusion characteristics (Table 2.4), he was able to determine that muskrat hunting primarily occurred in the spring (1988:353). This was based on the assumption that the last litters were born in September and the youngest individuals would have been approximately five months old in March. Most long bone fusion would be complete by this time (Thomas 1988:353). If muskrat hunting had primarily occurred in the fall, a higher proportion of subadults, born during the spring and late summer, would be represented by a greater number of unfused elements. These would include the distal humerus, the proximal radius, the distal tibia, and the calcaneal tuber, all of which generally fuse quite early (Munyer 1964:249).

A similar study was conducted for the Liahn I muskrat sample, the results of which are presented in Table 2.4. The Liahn I muskrat fusion parallels that observed at the Crawford Knoll site. However, given that nearly all of the early and mid-sequence fusing elements were either fused or in the process of fusing, the Liahn I muskrats were probably slightly older than those recovered from Crawford Knoll. It also appears that, in contrast to Munyer (1964), distal tibia fusion occurred following that of the calcaneal tuber, proximal femur, and proximal ulna in the Liahn I muskrat sample.

Together these data suggest that in comparison to the Crawford Knoll inhabitants, the Liahn I site occupants hunted muskrat slightly later in the spring and probably extended this activity into the early summer. The absence of unfused distal humeri, proximal radii, and calcaneal tubers in the Liahn I dataset implies that muskrat hunting was complete by the time the new litters ventured from their dens. The spring pursuit of muskrat may explain why fishing of the earliest spawners was not an important activity in this locale. Alternatively, the

Liahn I occupants may not have occupied the site until later in the spring or early summer, at which point percid and sucker spawning had already occurred. The high percentages of muskrat and bowfin (Table 2.3) identified in the Liahn I assemblage, two species that favour similar habitats, suggests that their procurement likely occurred simultaneously, probably during May and June. The focused exploitation of these two abundant resources is just one example of the Western Basin knowledge of species availability in southwestern Ontario.

Table 2.4. Muskrat fusion data for the Liahn I and Crawford Knoll assemblages

Liahn I							
Epiphysis	**Unfused**	**% Unfused**	**Fused**	**% Fused**	**Fusing**	**% Fusing**	**Total**
Distal Humerus	0	-	19	100	0	-	19
Proximal Radius	0	-	5	100	0	-	5
Distal Tibia	1	3.33	19	63.33	10	33.33	30
Calcaneal Tuber	0	-	30	100	0	-	30
Proximal Femur	0	-	14	100	0	-	14
Proximal Ulna	0	-	10	100	0	-	10
Distal Femur	27	96.43	0	-	1	3.57	28
Proximal Tibia	34	100	0	-	0	-	34
Distal Radius	7	100	0	-	0	-	7
Proximal Humerus	25	100	0	-	0	-	25
Total	94	46.53	97	48.02	11	5.45	202
Crawford Knoll							
Epiphysis	**Unfused**	**% Unfused**	**Fused**	**% Fused**	**Fusing**	**% Fusing**	**Total**
Distal Humerus	0	-	13	100	0	-	13
Proximal Radius	0	-	1	100	0	-	1
Distal Tibia	2	9.52	19	90.48	0	-	21
Calcaneal Tuber	1	5.26	18	94.74	0	-	19
Proximal Femur	8	16	42	84	0	-	50
Proximal Ulna	3	33.33	6	66.67	0	-	9
Distal Femur	16	100	0	-	0	-	16
Proximal Tibia	13	100	0	-	0	-	13
Distal Radius	1	100	0	-	0	-	1
Proximal Humerus	10	100	0	-	0	-	10
Total	54	35.29	99	64.71	0	-	153

Note: Elements are in the order of fusion, earliest to latest, following Munyer (1964:249). The fusion of the femoral head, greater, and lesser trochanters was combined here under one heading, proximal femur.

The paucity of small to medium terrestrial mammals (Appendix A: Table II), terrestrial birds (Appendix A: Table IV), and the absence of fall and winter spawning fish (Table 2.3) suggest that Liahn I was abandoned during the coldest part of the year (e.g., December to February). The site appears to represent a

warm season fishing and hunting settlement inhabited primarily from May to October, with some deer hunting in the fall and possibly into the winter. This assessment generally agrees with the one presented by Kenyon (1988); however, the muskrat data may place the occupation somewhat earlier (i.e., in the mid-to-late spring) than he originally determined. Subsistence activities were varied but intense at this locale. The dwelling structure and many overlapping pits identified at Liahn I imply both long-term and repeated occupation of the site by Western Basin peoples over several centuries.

Discussion

The analysis of the 10 selected zooarchaeological assemblages supports Murphy and Ferris's (1990) assertion of seasonal mobility among Ontario's Western Basin groups. However, their model of warm season river and near-lake settlements, complemented by interior cold season encampments, cannot account for some of the observed variability in season of site occupation suggested by the faunal evidence. It appears that patterns of seasonal subsistence and settlement incorporated a very high degree of flexibility. The ecological richness and diversity of the region provided Younge and Springwells families with a number of different options every season. These are outlined in the following section, and are summarized graphically in Figure 2.4. Table 2.5 summarizes the seasons of occupation for each of the examined sites.

The Western Basin Seasonal Round, A.D. 800-1400

Any attempt to model the seasonal round of a prehistoric group will mask some of the variation between families and that observed from year to year. Regardless, it is a useful exercise in reconstructing the broader patterns that persisted through time. The faunal data synthesized here indicate that Younge and Springwells peoples focused their subsistence efforts on the procurement of spring spawning fishes, especially the perch and sucker families, from April to May. Fishing, complemented by mammal and bird hunting and the collection of reptiles, amphibians, freshwater mussels, and snails, occurred at both river and

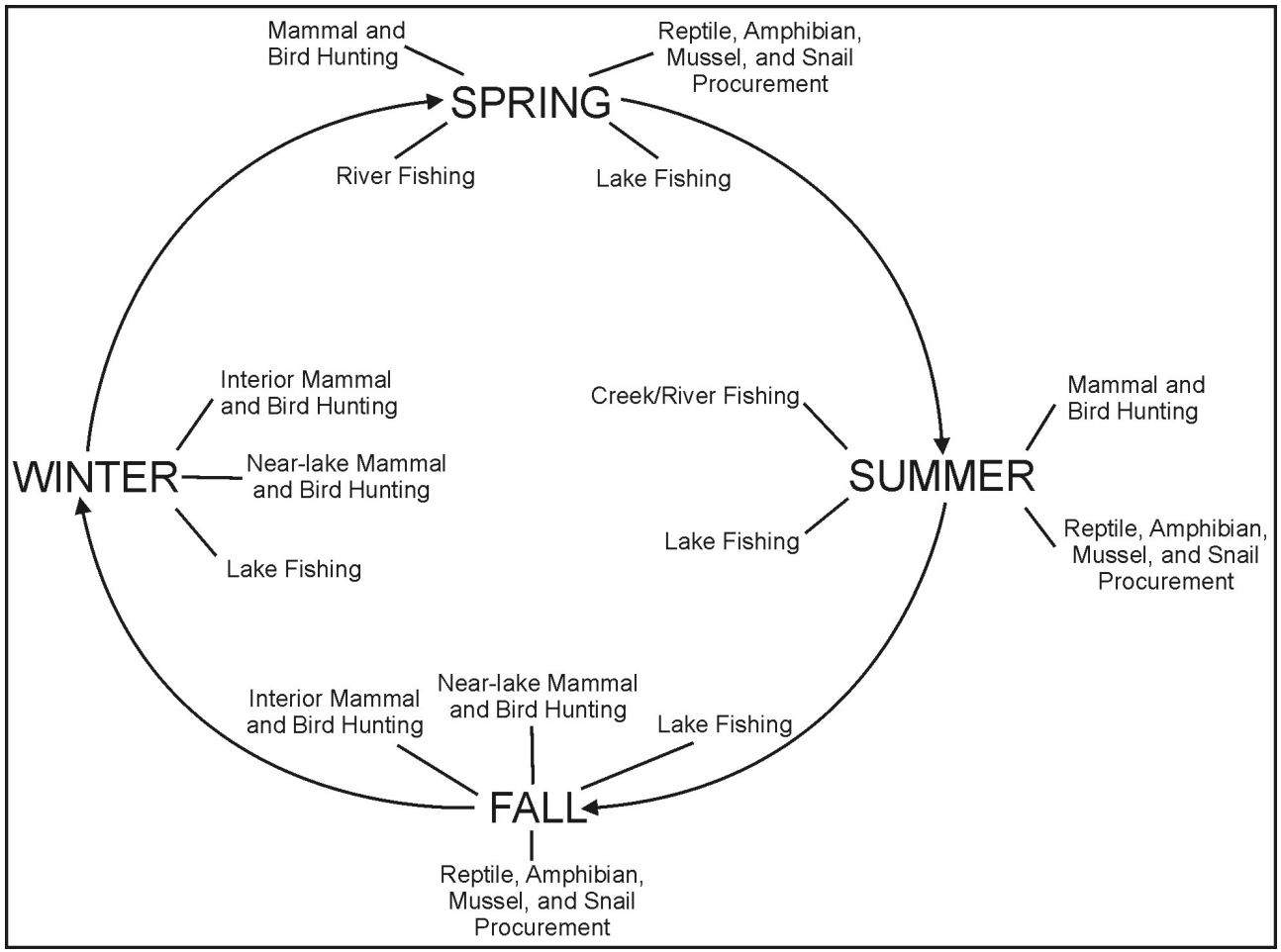
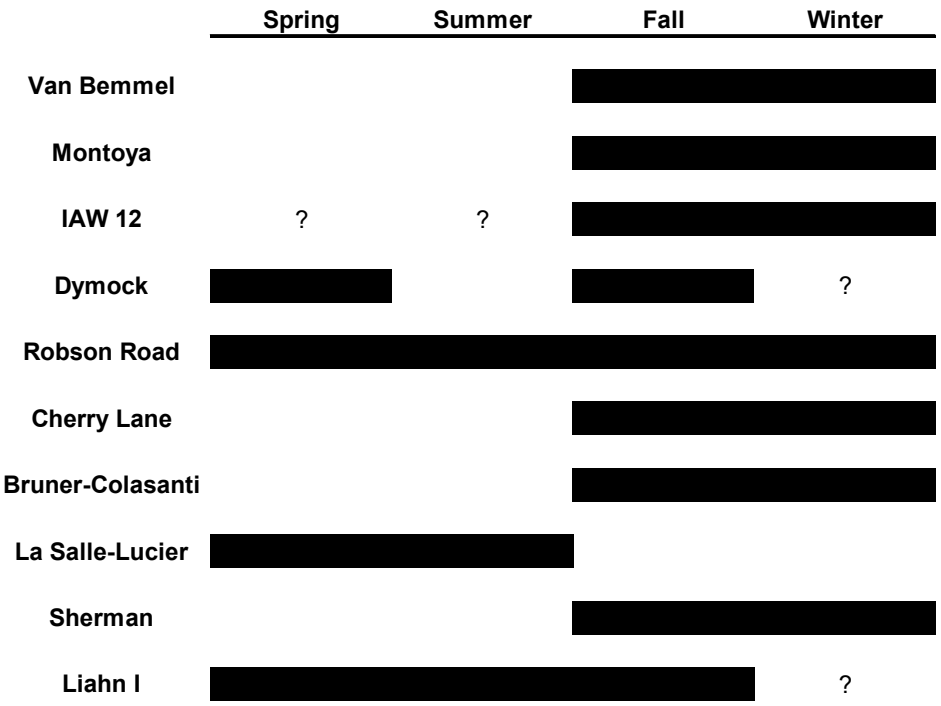


Figure 2.4. Ontario Western Basin seasonal faunal procurement activities and settlement locales, A.D. 800-1400. Primary exploitation activities are situated within the circle. Secondary exploitation activities are situated outside of the circle.

Table 2.5. Seasonality determinations for selected Younge and Springwells sites



near-lake locations. The Dymock site is a good example of the former, while Robson Road represents the latter.

Although some groups likely remained at their spring fishing locales throughout the warm season, there is evidence that by mid-June many families and communities moved to other river and near-lake settlements, such as La Salle-Lucier, for the duration of the warm season. Here they continued to exploit the abundance of available aquatic and terrestrial resources. A number of hunting and fishing parties likely departed from and returned to these settlements between June and September. Travel may have been frequent during this period for some individuals and groups, while others may have chosen to remain close to the settlement, fishing and hunting in the surrounding area.

In the early fall, likely mid-to-late October, most Younge and Springwells groups moved once again. Many families occupied interior sites, a large number of which were located within the primary and secondary drainages of the Ausable, Sydenham, and Thames rivers, where they hunted cervids,

rabbits/hares, squirrels, raccoon, black bear, mustelids, and wild turkey (Appendix A: Tables II and IV). The Van Bemmel, Montoya, Inland Aggregates West Location 12, Dymock, and Sherman sites exemplify this strategy. There is also evidence, however, of people spending time in more lake-oriented locales to fish and hunt during the fall and winter, as is suggested at Robson Road, Cherry Lane, and Bruner-Colasanti, all of which are located within a few kilometres of Lake Erie. Many Younge and Springwells families likely inhabited a number of different settlements during the cold season, moving to spend time with the extended family or, when resources became scarce. It is possible that some groups camping in the interior returned to areas closer to the lakes to fish and hunt, and vice-versa.

This model highlights the variability in Western Basin site location during different seasons within southwestern Ontario as well as in the mobility of some groups; however, it also emphasizes broad seasonal patterns in animal exploitation. Regardless of where people were in the region and the size of the group occupying the site, they conducted the same kinds of activities in each season. For example, the families occupying both the cold season interior Sherman and the near-lake Bruner-Colasanti sites hunted terrestrial mammals and birds. At riverine and lacustrine warm season sites, the emphasis expanded to include fishing, with this activity being the primary exploitation focus at some locales. Lake St. Clair bowfin were targeted by the Liahn I inhabitants, while percids were caught in great numbers from Lake Erie by the occupants of Robson Road.

These data also demonstrate the Younge and Springwells emphasis on harvesting locally abundant species, not just during the cold season, as was suggested by Stothers et al. (1994:158), but also during the warm season. The intensive spring to early summer procurement of muskrat at Liahn I is yet another example of this strategy. Clearly, the A.D. 800 to 1400 southwestern Ontario Western Basin seasonal round was even more flexible than Murphy and Ferris (1990) perceived. They were correct to stress the importance of surplus resource

caching by these peoples, for which there is evidence on both cold and warm season sites over the 600 years of interest.

As noted above, many of the selected sites were occupied for more than one purpose and during more than one season. Dymock represents an interior example and Robson Road a lake-oriented example of this multi-season use. At Dymock, faunal procurement focused on spawning percids and suckers as well as mammal hunting in the spring. Hunting and fishing activities continued throughout the warm season at this locale, with renewed hunting efforts, primarily of cervids, in the fall and possibly into the winter (Figure 2.2; Table 2.5). At Robson Road, people fished spring, summer, and winter spawners, hunted and collected throughout the summer, and hunted in the fall and winter. Western Basin peoples reoccupied both of these sites over several centuries in order to exploit different seasonal resources.

With the exception of Sherman and possibly Inland Aggregates West Location 12, researchers who investigated the sites included in this study noted that these locales were reused and reoccupied over time. Small family and task groups likely re-inhabited many of these areas for varying lengths of time, spanning from a few days to several months in any given year. Longer more intensive use of a locale is generally reflected by greater species diversity (e.g., Bruner-Colasanti versus Sherman; Table 2.3).

Younge and Springwells settlement decisions were also likely influenced by short- and long-term climatic fluctuations, which in turn may have affected local area species abundance and availability. These peoples adapted from year to year by occupying alternative areas within the region and by procuring other resources. Increasing or reducing group, and hence settlement size, also helped them to alleviate the effects of resource depression, and may provide insight into the variation in size of both warm and cold season sites. The Montoya and Inland Aggregates West 12 locales, and the Bruner-Colasanti site demonstrate that group coalescence was not solely a warm season phenomenon, as was implied by Murphy and Ferris (1990).

Conclusion

A southwestern Ontario case study was used here to illustrate how faunal species abundance, considered alongside site location and ecology, can be used to reconstruct season of site occupation and the annual mobility of prehistoric peoples. Faunal assemblages recovered from 10 sites, varying in location, size, and intensity of occupation, were examined in order to identify the scheduling of and the preferred areas for hunting and fishing activities. Between A.D. 800 and 1400, Younge and Springwells phase people inhabited interior and near-lake locales where they hunted and fished locally available species. During the warm season, groups ranging in size from one to several families lived along the shores of major rivers and lakes where they procured both aquatic and terrestrial resources. While some families remained at these locales to continue hunting and fishing in the fall and winter, others moved to more protected river valley areas for this purpose.

It appears that, regardless of where these people were situated in the region and the size and composition of their groups, they conducted similar kinds of subsistence activities at the same time of year. Their seasonal round was organized, yet flexible to ensure survival, and the location, duration, and variety of annual hunting and fishing activities available to them were greater than those previously recognized. Despite the noted consistency in seasonal activities, both regional and temporal variability in Western Basin mobility and resource preferences were identified during the course of this study. The observed regional trends in faunal procurement strategies will be examined in a future paper; however, the temporal changes in hunting and fishing practices are explored in detail in the following chapter where they are compared to the subsistence and settlement strategies of neighbouring Iroquoian groups.

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CHAPTER III

ZOOARCHAEOLOGICAL INSIGHTS INTO CULTURAL SUBSISTENCE AND SETTLEMENT STRATEGIES IN SOUTHWESTERN ONTARIO, A.D. 800-1600

Flannery's (1969) Broad Spectrum Revolution model suggested, based on evidence from Upper Palaeolithic sites in the Near East, that communities transitioning from a foraging economy to food production broadened their subsistence bases to include additional, often previously overlooked animal species. Edwards (1989) demonstrated a greater time depth for a diversified economy in the Near East and identified (1989:241) the global use of broad-based foraging strategies by prehistoric, historic, and modern hunter-gatherer-fishers, incipient farmers, sedentary agriculturalists, and urbanites as a means of ensuring their survival. While the motivation to adopt this approach varies by context, the most common reasons include the reduced availability of preferred species, population growth, and/or scheduling conflicts with other subsistence or social activities.

Similar subsistence shifts are documented here for late precontact southwestern Ontario (Figure 3.1). This study represents the first attempt to analyze and interpret the Late Woodland zooarchaeological record uncovered during the past few decades by academic and cultural resource management (CRM) archaeologists working in this part of the province (Ferris 1998). Between A.D. 800 and 1600, Western Basin and Iroquoian peoples practiced a mixed subsistence economy, in which they combined the hunting, fishing, and collecting of locally available animals and plants with the growing of domestic crops. I argue that despite some broad similarities in faunal exploitation patterns over time resulting from an increasing emphasis on agriculture, members of these traditions maintained very distinct animal procurement practices.

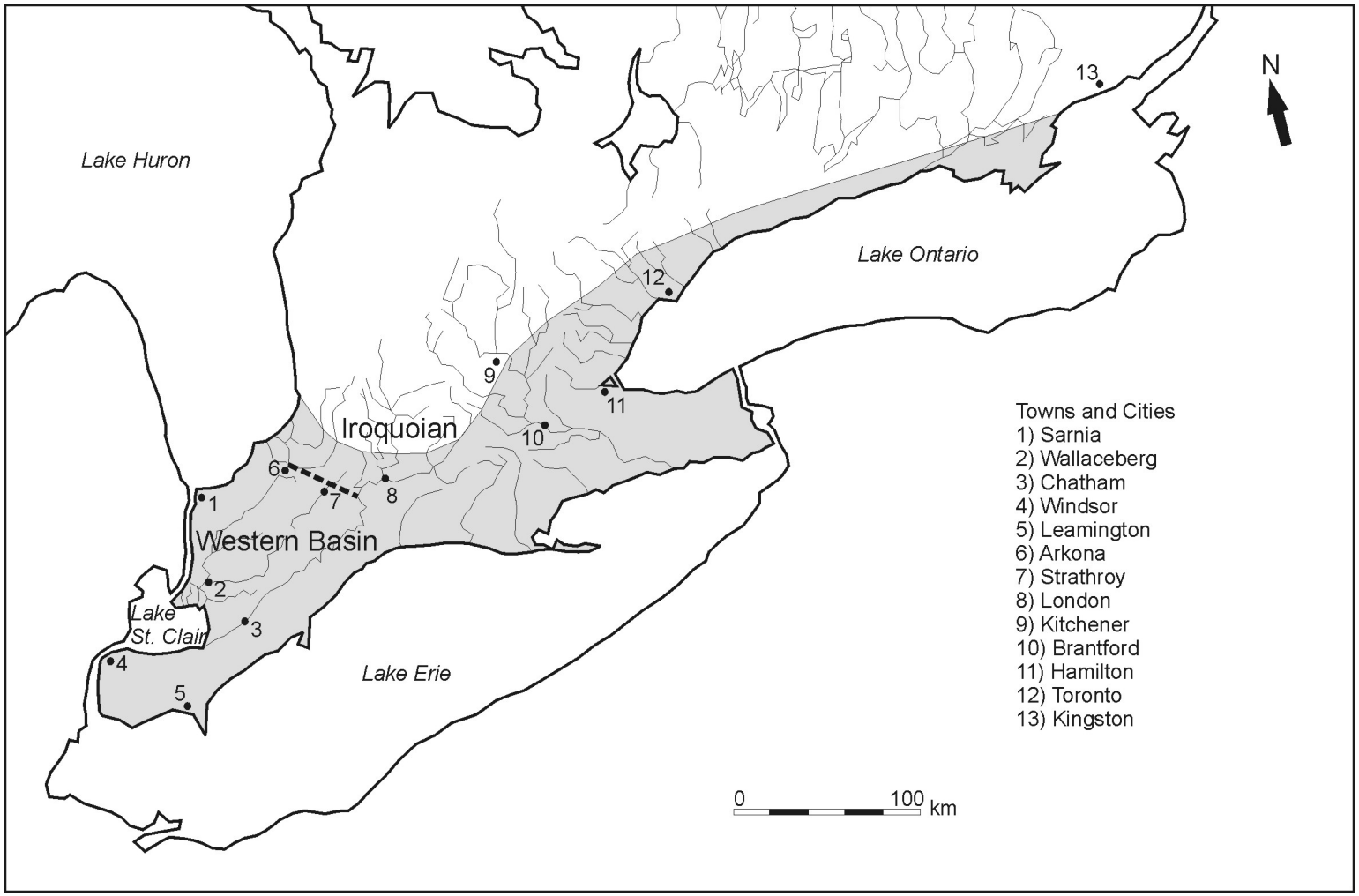

Figure 3.1. Southern Ontario's archaeological landscape, A.D. 800-1600. Dotted line is the eastern-most zone of Western Basin and Iroquoian contact. Shaded area is the current northern limit of the Carolinian forest.

During the 800 years examined in this study, both groups diversified their hunting and fishing foci. A significant decrease in the hunting of large mammals is accompanied by more intensive exploitation of small to medium mammals, fish, birds, reptiles, amphibians, and invertebrates. Both traditions decreased their procurement of suckers (catostomids), white-tailed deer, raccoon, and wild turkey over time, likely resulting from scheduling conflicts with the spring planting and fall harvesting of domestic crops. As agricultural efforts intensified, faunal procurement activities became increasingly focused near the settlement and additional animal species began to be exploited.

Although many commonalities are observed between the Western Basin and Iroquoian subsistence approaches, the archaeofaunal record also demonstrates significant differences in the hunting and fishing practices of these two traditions. Fishing was integral to the Western Basin subsistence economy year-round, and is reflected in the riverine and near-lake locations of their settlements (Figures 3.2 and 3.3). Iroquoians, on the other hand, chose to intensively hunt terrestrial mammals and birds. Fishing and the collection of reptiles, amphibians, and invertebrates also occurred in the tributaries, creeks, and ponds near their settlements (Figures 3.2 and 3.3) between A.D. 800 and 1600. These distinct patterns of faunal procurement further support Cunningham (2001) and Watts' (2008) assertions, based on ceramic morphology, decoration, and symmetry, that Western Basin and Iroquoian communities differed significantly in their views of and interactions with the environment.

Southwestern Ontario's Archaeological Occupants, A.D. 800-1600

The Geographic, Environmental, and Cultural Setting

The region of interest, which spans from present-day Sarnia and Windsor to the Greater Toronto Area (GTA) (Figure 3.1), lies predominantly within the Carolinian forest. This rich and diverse ecosystem is composed of a variety of broad-leaved trees, coniferous trees, and grasses, located within swamp, floodplain, upland, and sand dune habitats (The Centre for Land and Water Stewardship, University of Guelph 1994; Colthurst and Waldron 1993; Kavanagh

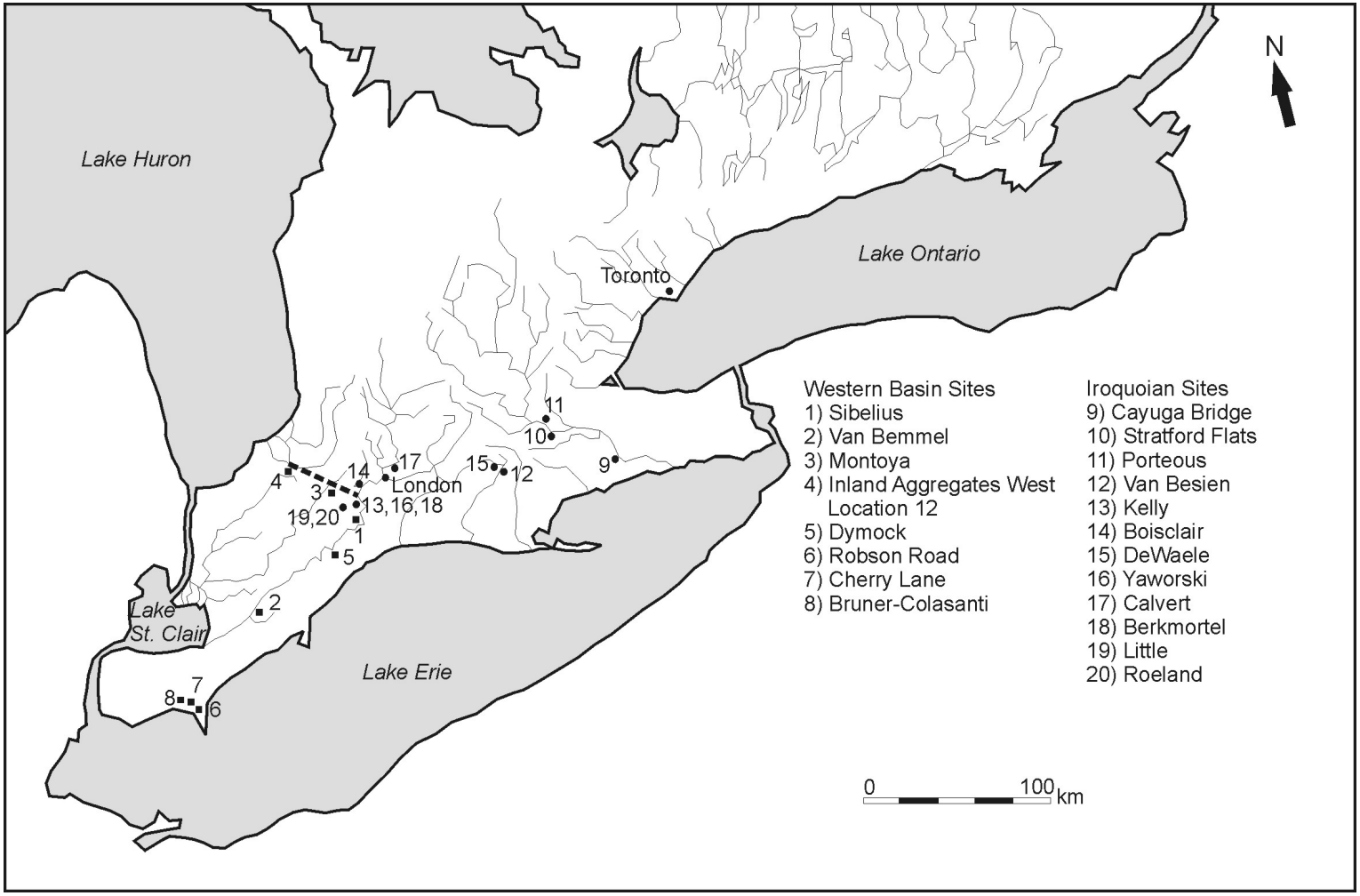

Figure 3.2. Southwestern Ontario archaeological sites, A.D. 800-1200. Western Basin sites are represented by squares, Iroquoian sites are represented by circles.

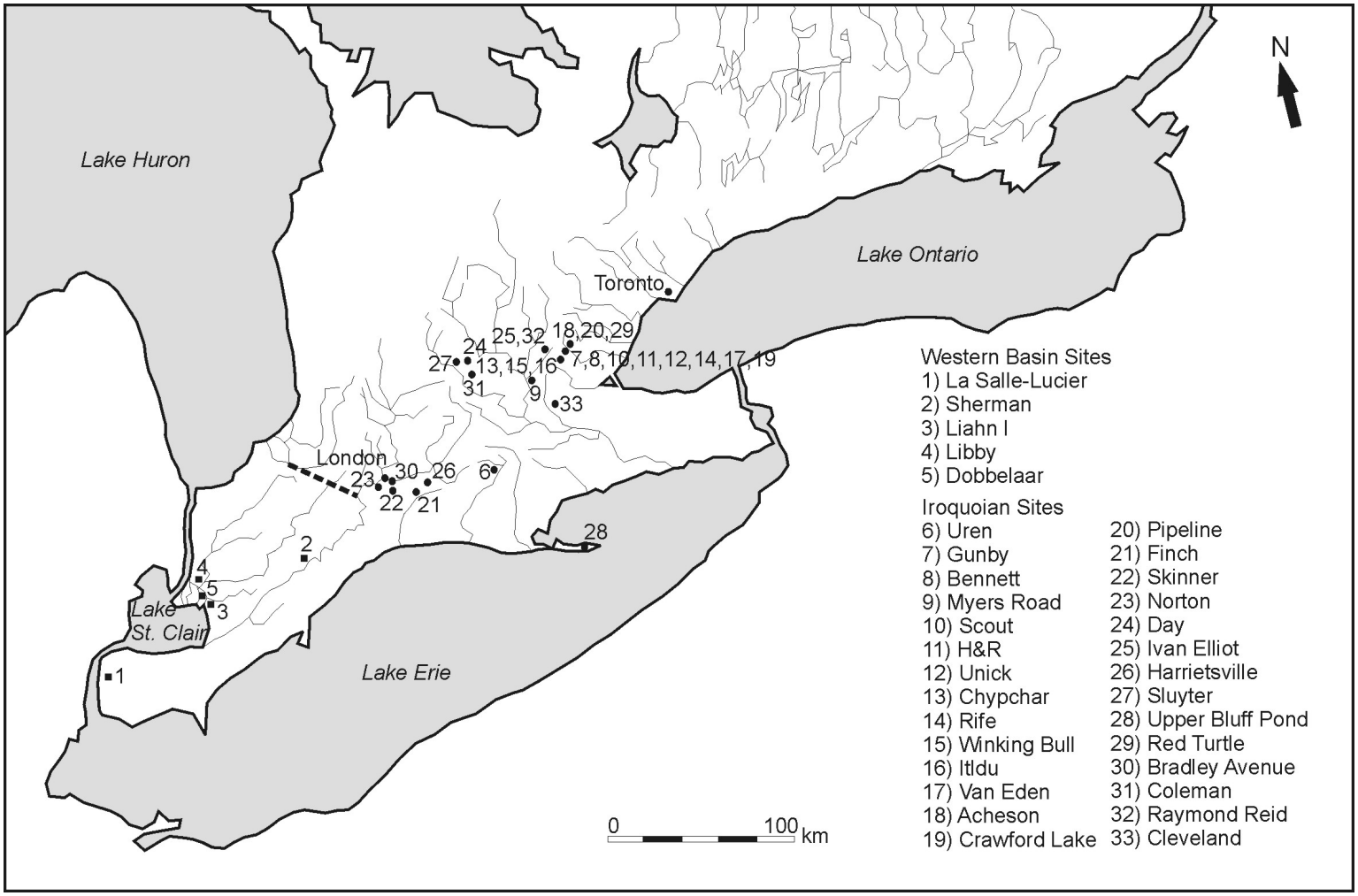

Figure 3.3. Southwestern Ontario archaeological sites, A.D. 1200-1600. Western Basin sites are represented by squares, Iroquoian sites are represented by circles.

et al. 1999; Waldron 2003). The region has the warmest average annual temperature, the longest frost-free seasons, and the mildest winters in Ontario.

Late precontact Western Basin and Iroquoian occupations are divided into four roughly contemporaneous phases (Table 3.1). These designations are based on a combination of ceramic vessel form and decoration, lithic tool types, organic tools and decorative items, and settlement patterns (Dodd et al. 1990; Fox 1990; Lennox and Fitzgerald 1990; Murphy and Ferris 1990; Warrick 2000:418; Williamson 1990).

Table 3.1. Southwestern Ontario's Archaeological Traditions, A.D. 500-1700

Tradition	Phase	Temporal Range (A.D.)	Sources
Western Basin	**Riviere au Vase**	500-900	Murphy and Ferris (1990)
	Younge	800-1200	
	Springwells	1200-1400	
	Wolf	1400-1600	
Ontario Iroquoian[1]	**Princess Point**	500-1000	Ferris (1999:19);
	Early Iroquoian	900-1300	Ferris and Spence (1995);
	Glen Meyer, Pickering		D. Smith (1997);
	Middle Iroquoian	1300-1400	Warrick (2008:109);
	Uren, Middleport		Wright (1966)
	Late Iroquoian	1400-1700	
	Neutral		

a – Following D. Smith (1990:279) and Trigger (1978:3), the term *Iroquoian* describes hypothesized precontact, contact, and historic Iroquoian-speaking groups who occupied the lower Great Lakes region, while the term *Iroquois* is reserved for the historic Five Nations (i.e. Onondaga, Oneida, Mohawk, Seneca, and Cayuga) of New York State.

Most of the known Ontario Western Basin components have been documented in salvage or cultural resource management contexts. Sites stretch from the London area west to present-day Sarnia and Windsor, with clusters near Strathroy, Arkona, Chatham, Leamington, and Wallaceburg (Figures 3.1, 3.2, and 3.3). To date, very few early (Riviere au Vase) and late (Wolf) sites have been documented in the province, and the A.D. 1000 to 1400 period, which includes the second half of the Younge phase and the entire Springwells phase, is the best represented (Chapter 2; Table 3.2). Recent surveys (e.g., Crawford and Smith 2002) have identified additional sites; however, they require further investigation. Until these data become available, the geographic extent and density of Ontario's Western Basin occupation remain unclear.

Table 3.2. Western Basin sites, A.D. 800-1600

	Site	NISP	Faunal Analyst	References
A.D. 800 -1200	**Sibelius (AfHi-13)**	718	J. Cooper 1982	Fox 1982a
	Van Bemmel (AcHm-31)	3764	Prevec 1988a	Ferris 1989a
	Montoya (AfHi-243)	6127	Foreman, this study	Archaeologix Inc. 2004
	Inland Aggregates West Location 12 (AgHk-60)	2275	Foreman, this study	Archaeologix Inc. 2008
	Dymock (AeHj-2)	10347	Prevec 1981a	Fox 1982b
	Robson Road (AaHp-20)	6517	Prevec 1988b	Kenyon et al. 1988
	Cherry Lane (AaHp-21)	3343	Prevec 1989	Ferris and Mayer 1990
	Bruner-Colasanti (AaHq-8)	8948	B. Smith 1981	Lennox 1982
A.D. 1200 -1600	**LaSalle-Lucier (AbHs-8)**	1093	Dodd 1991	Lennox and Dodd 1991
	Sherman (AdHl-16)	5571	Prevec 1988c	Murphy 1991
	Liahn I (AcHo-1)	12899	Foreman, this study	Kenyon 1988
	Libby (AdHo-20)	13119	Prevec 1991a, 1993	Arnold et al. 1994; Ferris et al. 1990; Fitzgerald and W. Stewart 1994; W. Stewart 1991, 1992, 1994
	Dobbelaar	5187	Foreman, this study	Neal Ferris, personal communication 2006

CRM archaeology has also increased the number of known Iroquoian sites in Ontario. Later components, dating between A.D. 1200 and 1600, outnumber earlier ones (Table 3.3). The large villages that characterize this 400-year period are also more visible to archaeologists than Western Basin sites. In southwestern Ontario, they span from present-day Chatham east and north to Brantford, Hamilton, Kitchener, and the GTA (Figures 3.1, 3.2, and 3.3). Available evidence suggests that Iroquoians employed a greater variety of formal settlement types, including hunting and fishing camps and agricultural cabins, than their Western Basin neighbours (Bamann et al. 1992:440, 445; Dodd et al. 1990; Lennox and Fitzgerald 1990; Williamson 1990). Recent work at several large sites (e.g., Calvert, Myers Road) suggests much longer periods of occupation, both during the year and over time, in these locales than would be expected based solely on the ethnohistoric record.

Native Subsistence and Settlement Strategies in Southwestern Ontario, A.D. 800-1600

Ontario's Western Basin communities have traditionally been described as seasonally mobile hunters, fishers, and gatherers, who supplemented their diet with small amounts of domestic crops (Murphy and Ferris 1990). Archaeological and laboratory research during the past decade has, however, resulted in the re-evaluation of the overall importance of domesticates in the Western Basin diet. The recovery of significant amounts of macro-botanical remains from a number of sites in the Arkona area (Ferris and Wilson 2009), and the recent isotopic analysis of human tissues from several contexts (Dewar et al. 2010; Watts et al. 2011) suggests that maize contributed to the Western Basin diet as much as it did to the diet of neighbouring Iroquoian communities (see Harrison and Katzenberg 2003; Katzenberg et al. 1995; Schwarcz et al. 1985; van der Merwe et al. 2003a, b). Isotopic studies of Western Basin human tissues recovered in Michigan (Allegretto 2007; Schurr and Redmond 1991) and Ohio (Allegretto 2007; Stothers and Abel 2002; Stothers and Bechtel 1987) further support the dietary importance of maize to these peoples.

Table 3.3. Iroquoian sites, A.D. 800-1600

	Site	NISP	Faunal Analyst	References
A.D. 800 -1200	**Cayuga Bridge (AfGx-1)**	575	Burns 1972a	Stothers 1977
	Stratford Flats (AgHb-50)	237	Prevec 1983a	Fox 1984
	Porteous (AgHb-1)	2753	Burns 1972b	Noble and Kenyon 1972; Stothers 1977; Stothers and Kenyon 1970
	Van Besien (AfHd-2)	4967	Burns 1973	Noble 1975
	Kelly (AfHi-20)	2292	D. Pihl 1981	Williamson 1985
	Boisclair (AfHh-28)	1757	Prevec 1983b	Prevec 1983b
	DeWaele (AfHd-1)	2824	Burns	Fox 1976
	Yaworski (AfHi-21)	566	Ambrose and Pegg	Williamson 1985
	Calvert (AfHg-1)	46051	Prevec 1984	Fox 1982c; Timmins 1997
	Berkmortel (AfHi-32)	3154	Pegg	Williamson 1985
	Little (AfHj-28)	674	Salvaggio	Williamson 1985
	Roeland (AfHj-14)	2273	Pegg	Williamson 1985

Table 3.3 Continued

	Site	NISP	Faunal Analyst	References
A.D. 1200 -1600	**Uren (AfHd-3)**	3611	M. Wright 1986	Wintemberg 1928; J. Wright 1966; M. Wright 1986
	Gunby (AiGx-5)	15078	Warrick 1978	Rozel 1979
	Bennett (AiGx-1)	2273	Fairgrieve 1988; Marti 1988	Finlayson 1998; J. Wright 1966; J. Wright and Anderson 1969
	Myers Road (AiHb-13)	5514	Thomas et al. 1998	MacDonald et al. 1989; Thomas et al. 1998; Williamson 1998
	Scout (AiGx-156)	221	Haines 1990	Finlayson 1998
	H&R (AiGx-91)	226	Mullen 1986	Finlayson 1998
	Unick (AiGx-11)	481	Rankin 1994	Finlayson 1998
	Chypchar (AiGx-73)	810	Boutin-Sweet 1981; Graham 1981	Finlayson 1998
	Rife (AiGx-7)	548	Balmer 1975	Finlayson 1998
	Winking Bull (AiHa-20)	1704	Barnhardt 1986; Casey 1987; Matilla 1987	Finlayson 1998
	Itldu (AiHa-25)	261	Komar 1993	Finlayson 1998
	Van Eden (AiGx-8)	243	Renzoni 1994	Finlayson 1998
	Acheson (AiGx-146)	201	Pudden 1995	Finlayson 1998
	Crawford Lake (AiGx-6)	1036	Heathcote and Burns; Frame 1987	Finlayson 1998
	Pipeline (AiGx-12)	348	Busby 1979	Busby 1979; Finlayson 1998
	Finch (AeHg-58)	426	Carscallen and Thomas 1991; Thomas	R. Pihl and Thomas 1997
	Skinner (AfHg-13)	978	Henderson 1986	Henderson 1986; Keron 1989
	Norton (AfHh-86)	233	Thomas 1992	Cooper and Robertson 1993
	Day (AiHd-73)	443	Prevec 1991b; Dodd	Dodd and Riddell 1995
	Ivan Elliot (AiHa-16)	365	Fram 1985; Wilson 1986	Finlayson 1998; Fitzgerald 1990
	Harrietsville (AfHf-10)	2581	Henderson 2006	Henderson 2006; Keron 1983, 2010
	Sluyter (AiHd-82)	609	Prevec 1991c; Dodd	Lennox and Hagerty 1995
	Upper Bluff Pond (AdHa-7)	8229	Prevec	Prevec and Fox 1989
	Red Turtle (AjGx-130)	266	Pudden 1995	Finlayson 1998
	Bradley Avenue (AfHh-160)	1506	Prevec 1991d; Dodd	Lennox 1995
	Coleman (AiHd-7)	803	Needs-Howarth 1995	MacDonald 1986; Needs-Howarth 1995
	Raymond Reid (AiHa-4)	310	Riosa 1984	Finlayson 1998; Fitzgerald 1984, 1990
	Cleveland (AhHb-7)	7360	Prevec 1981b	Prevec 1981b

Based on this new evidence, it appears that southwestern Ontario's Western Basin communities practiced a mixed subsistence economy much earlier than was previously suggested (Murphy and Ferris 1990). As was outlined in Chapter 2, their preferred animal species were procured at a number of seasonally occupied settlements, located near the many rivers, tributaries, and lakes of the region.

In comparison, Iroquoian peoples predominantly inhabited upland areas near secondary water sources where they established larger, more permanent settlements that were occupied by at least a small number of individuals throughout the year (Dodd et al. 1990; Warrick 2000; Williamson 1990). Over time, the construction and organization of individual dwellings and settlements became much more structured (Dodd et al. 1990:343, 349, 350; Ferris and Spence 1995; Lennox and Fitzgerald 1990:444; Williamson 1990:304), adhering to a known and accepted set of community ideals. Individuals, families, and specialized task groups set out from these settlements for varied lengths of time over the course of the year to hunt, fish, collect, trade, visit, etc. (Lennox and Fitzgerald 1990; Warrick 2000; Williamson 1990:317, 318), taking advantage of both locally available and more distant resources (Dodd et al. 1990; Lennox and Fitzgerald 1990). The procured fauna supplemented the squash, maize, sunflower, and bean crops grown and harvested in fields near the settlements.

Assembling, Organizing, and Analyzing the Datasets

Numerous published and unpublished reports were examined during the compilation of the Western Basin and Iroquoian datasets. Only sites dating between A.D. 800 and 1600, representing occupation by members of one, not both, of these archaeological traditions, and with a minimum assemblage size of 200 specimens, were included. Given the limited number of Western Basin faunal reports available, the analysis of four additional assemblages (i.e., Montoya, Inland Aggregates West Location 12, Liahn I, Dobbelaar) not only enlarged the available dataset, but also helped to improve our understanding of the early and late phases of settlement within the region.

The 13 Western Basin and 40 Iroquoian assemblages chosen for this study are listed in Tables 3.2 and 3.3, while their locations are illustrated in Figures 3.2 and 3.3. Assemblage size varies greatly from site to site, with the smallest being Acheson (n=201) and the largest Calvert (n=46051). Although fewer in number, Western Basin assemblages tend to be larger, on average, (mean=6147, median=5187) compared to Iroquoian ones (mean=3120, median=810).

Known Iroquoian settlements are dispersed throughout the region, while Western Basin sites are concentrated within the southwestern-most portion (Figures 3.2 and 3.3). River, tributary, and lake-oriented occupations are all represented in the Western Basin sample, while nearly all of the Iroquoian study sites are located along the tributaries of major rivers. With the exception of Upper Bluff Pond, faunal data were not available from the known Iroquoian near-lake settlements.

In order to examine intra- and inter-community faunal procurement activities over time, the chosen Western Basin and Iroquoian sites were assigned to either an early or a late period of occupation. The selected arbitrary dividing point was A.D. 1200; it splits the 800 years of interest into two smaller, equal, 400-year blocks. The early period, which dates between A.D. 800 and 1200, includes Riviere au Vase and Younge phase Western Basin contexts and Princess Point and early Iroquoian ones. The late period, spanning from A.D. 1200 to 1600, includes Springwells and Wolf phase Western Basin sites and transitional early to middle, middle, and late Iroquoian ones.

The assembled datasets include the known range of settlement types and subsistence foci of both traditions. These vary in size from small short-term camps to large seasonal and year-round villages. Combining the data from many sites and comparing two broad temporal periods (A.D. 800-1200 and A.D. 1200-1600) enables us to examine both short- and long-term trends in the faunal procurement strategies of each tradition, to compare the preferred hunting and fishing locations during both periods, and finally, to identify how the intensification

of agricultural production by both groups over time affected prey selection and the scheduling of faunal procurement activities.

A regional study of this scope necessarily examines faunal assemblages collected using different recovery techniques (i.e., by hand, screening, flotation) and analyzed by different zooarchaeologists. For two decades, the Ontario Ministry of Tourism and Culture (OMTC), which governs archaeological activities in the province, has mandated the use of 6 mm mesh for the screening of all cultural fill. During the 1970s and 80s the Ministry more informally advocated for hand screening through 6 mm mesh as well as for the collection of flotation samples from at least a representative sample of features being excavated. As indicated in Tables 3.2 and 3.3, most of the selected sites were excavated when hand screening of cultural fill through 6 mm mesh was formally or informally required; the faunal reports indicate that at least a sample of the floated fauna was analyzed in most cases. The few assemblages that did not include the specimens recovered from floated contexts will likely have higher relative frequencies of larger animals, especially mammals. Previous researchers (e.g., Clason and Prummel 1977; James 1997; Shaffer 1992; Shaffer and Baker 1999; Shaffer and Sanchez 1994; F. Stewart 1991; Struever 1968) have demonstrated that in these situations, the remains of smaller animals, such as rodents, birds, reptiles, amphibians, and snails, and of animals with many small body parts, such as fish, tend to be underrepresented.

The assemblages excavated in the 1960s and early 1970s, including those from the Cayuga Bridge, Porteous, Van Besien, DeWaele, Bennett, and Cleveland sites, were usually recovered using a combination of hand collection, screening, and/or flotation. Given that the majority of the selected faunal assemblages were at least screened, and that the focus here is on examining broad subsistence trends over an 800-year period, it is unlikely that the reconstructions of Western Basin and Iroquoian hunting and fishing practices will be greatly affected by differences in recovery techniques between assemblages.

Only specimens identified to class or lower level were included in this study. To facilitate inter-assemblage comparisons, they are presented as counts,

or numbers of identified specimens (NISP). Comparisons of faunal procurement practices between periods of occupation and cultural traditions are also based on percentages of the total NISP for each assemblage.

This study examines the proportions of the main faunal classes, mammal, fish, and bird categories, both within and between the Western Basin and Iroquoian datasets, in order to identify differences in their exploitation over time. As the samples are large, the central limit theorem may be used to compare the proportions of these categories, treating them as special cases of means (Blalock 1972:193). The z statistic is used here to identify: differences in the proportions of the animal taxa exploited in the early (A.D. 800-1200) versus the late (A.D. 1200-1600) period of occupation; and differences in the proportions of the animal taxa exploited by Western Basin, compared to Iroquoian peoples. It tests the null hypothesis that there is no difference between the two proportions [i.e., $(p_1-p_2) = 0$, p_1 = proportion 1, p_2 = proportion 2], and in this study, is calculated following McClave and Sincich (2000:404):

$$z = (\hat{p}_1-\hat{p}_2)/\sigma_{(\hat{p}_1-\hat{p}_2)}$$

where,

$\hat{p}_1$ = sample proportion 1

$\hat{p}_2$ = sample proportion 2

$(\hat{p}_1-\hat{p}_2)$ is an unbiased estimator of (p_1-p_2)

$\sigma_{(\hat{p}_1-\hat{p}_2)} = \sqrt{p_1q_1/n_1 + p_2q_2/n_2} \approx \sqrt{\hat{p}\hat{q}(1/n_1+1/n_2)}$, $\hat{p} = x_1+x_2/n_1+n_2$, x = total number of the character of interest, and n = sample size, representing the standard deviation of the sampling distribution.

The calculated z value is compared to the z value of the chosen level of significance (e.g., $\alpha = 0.01$, $z_\alpha = 2.33$; Table 3.4). The null hypothesis can be rejected if and only if, the calculated z value is: larger than the z_α value for the alternative hypothesis that $(p_1-p_2) > 0$; larger than the $z_{\alpha/2}$ value for the alternative hypothesis that $(p_1-p_2) \neq 0$; and smaller than the $-z_\alpha$ value for the alternative hypothesis that $(p_1-p_2) < 0$. The null and alternative hypotheses, rejection regions, and most common α values for both one- and two-tailed large-sample tests of hypothesis about (p_1-p_2) are summarized in Table 3.4.

Table 3.4. Summary characteristics for large sample tests of hypothesis about (p_1-p_2) (McClave and Sincich 2000:283, 404)

	One-tailed Test	Two-tailed Test
H_0	$(p_1-p_2) = 0$	$(p_1-p_2) = 0$
H_a	$(p_1-p_2) < 0$ or $(p_1-p_2) > 0$	$(p_1-p_2) \neq 0$
Rejection Region	$z < -z_\alpha$ or $z > z_\alpha$	$\|z\| > z_{\alpha/2}$
α = 0.01	$z_\alpha = 2.33$	$z_{\alpha/2} = 2.575$
α = 0.05	$z_\alpha = 1.645$	$z_{\alpha/2} = 1.96$
α = 0.10	$z_\alpha = 1.285$	$z_{\alpha/2} = 1.645$

Results

A detailed examination of the Western Basin and Iroquoian datasets reveals several interesting faunal procurement trends between A.D. 800 and 1600. Cervids (deer) supported the economies of both traditions, although their importance decreased through time. These peoples also increased the number of fish species that they were exploiting during the 800 years of interest and shifted from an emphasis on turkeys to passenger pigeons and waterfowl. However, as will be demonstrated here, there were also important differences between the two groups in their use of certain key mammal and fish species.

Figure 3.4 clearly illustrates that mammals, primarily represented by cervids (Figure 3.5; Table 3.5), account for the largest proportion of Western Basin and Iroquoian assemblages during the early and late periods of occupation. After A.D. 1200, it appears that both traditions decreased their exploitation of mammals while simultaneously increasing their procurement of fish, birds, reptiles, amphibians, and invertebrates (i.e., mussels, snails). A comparison of the proportions of the main faunal categories from the early period of occupation to those from the late period (Appendix D: Table I) verify the significance of these trends at the α=0.01 level.

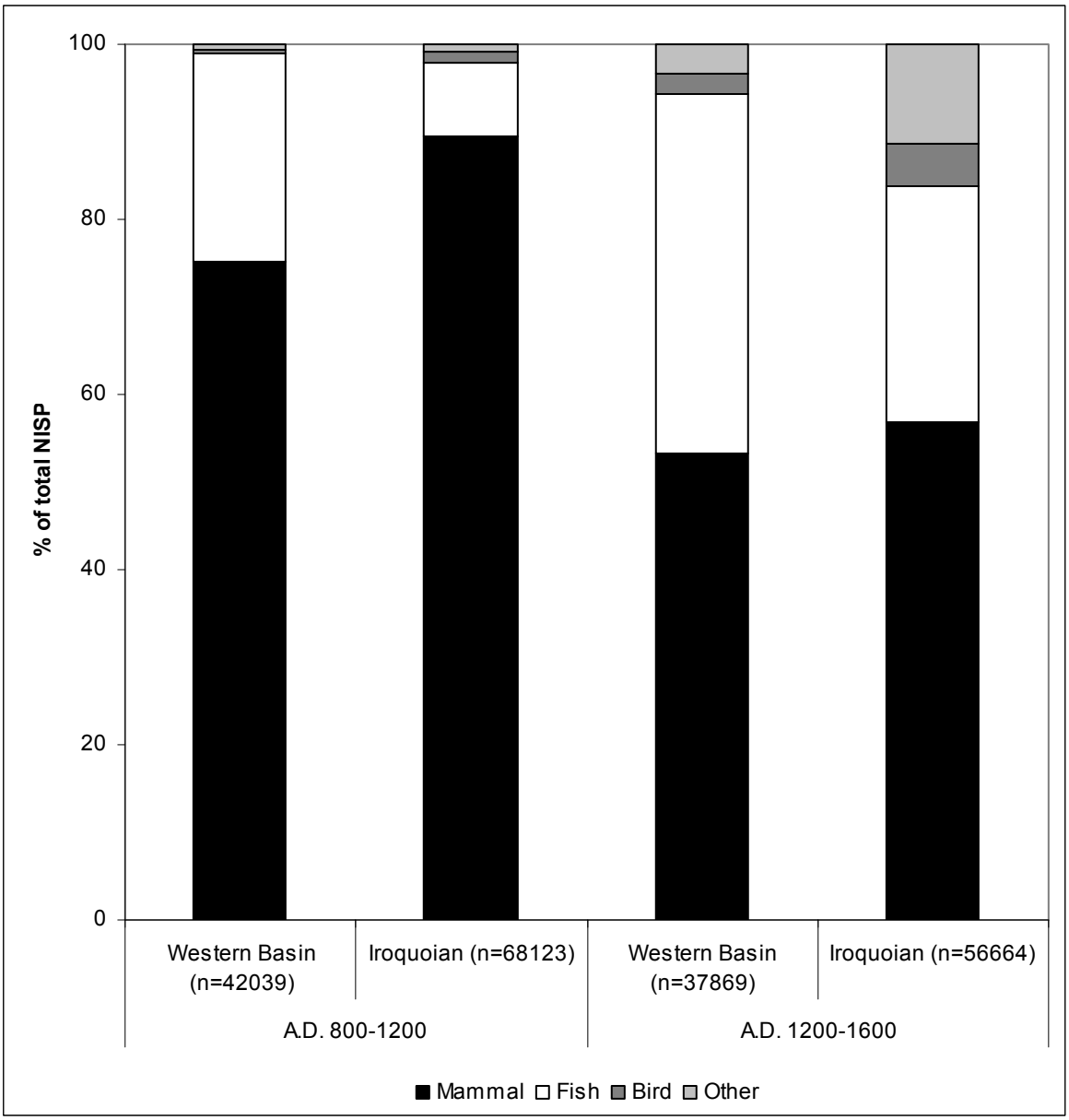

Figure 3.4. Main faunal class representation for the A.D. 800-1200 and A.D. 1200-1600 periods. The other category includes reptiles, amphibians, mussels, snails, and crustaceans.

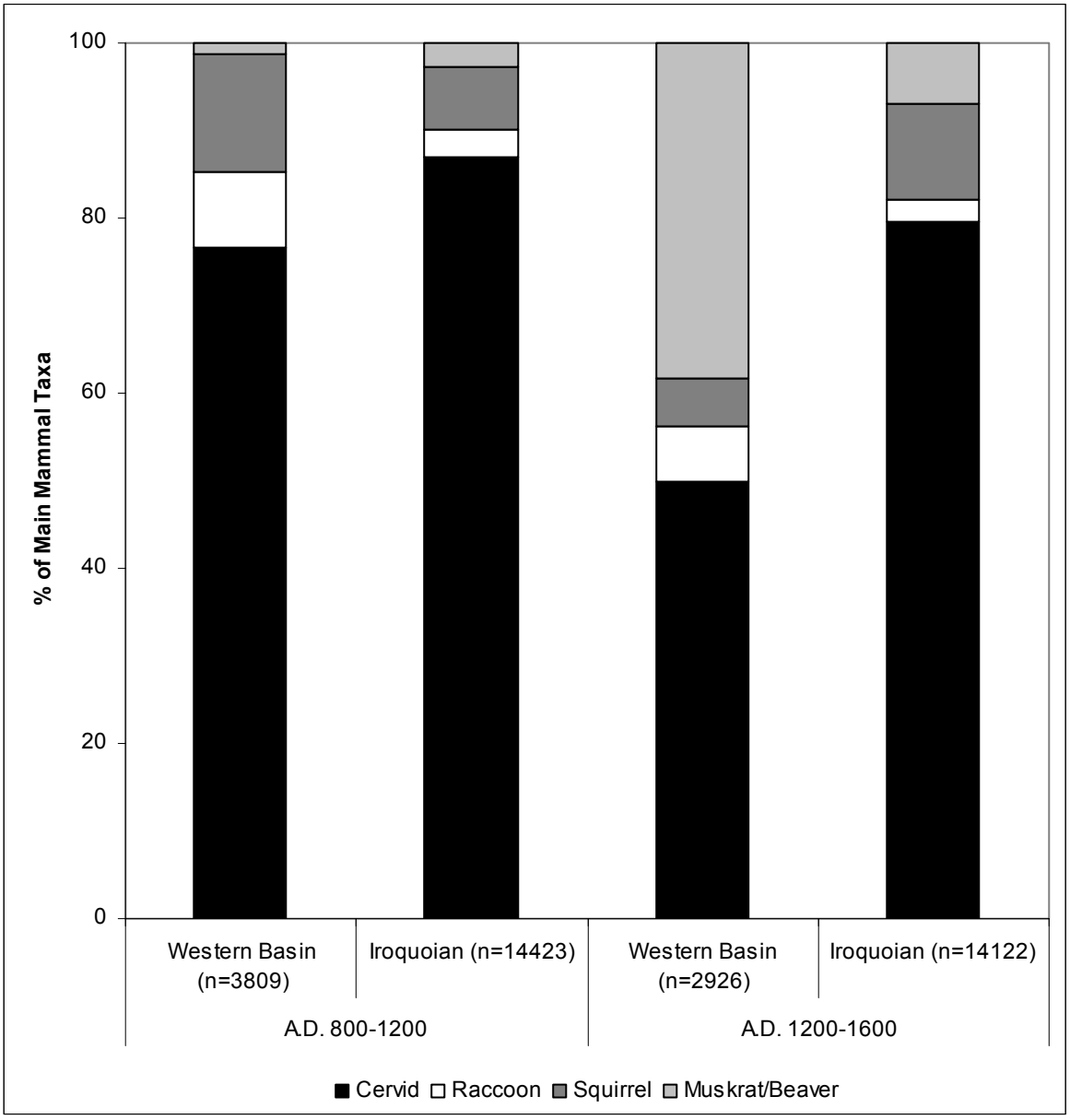

Figure 3.5. Main mammal taxa representation for the A.D. 800-1200 and A.D. 1200-1600 periods. Cervid = white-tailed deer, wapiti/elk, moose, and other cervid, Squirrel = eastern chipmunk, eastern gray squirrel, red squirrel, and other squirrel.

Table 3.5. Identified mammal species and families from southwestern Ontario sites, A.D. 800-1600

	Western Basin			
Taxon	A.D. 800-1200 (n=8)	A.D. 1200-1600 (n=5)	Z-value	% Confidence Level
White-tailed deer	2763 (59.55)	1314 (39.60)	17.53	100
Elk	4 (0.09)	4 (0.12)	0.06	52.3
Moose	2 (0.04)	0	0.39	65.3
Other cervid	148 (3.19)	141 (4.25)	2.43	99.2
Eastern cottontail	0	0	-	-
Snowshoe hare	0	0	-	-
Other leporid	0	23 (0.69)	5.44	100
Eastern chipmunk	76 (1.64)	27 (0.81)	3.13	99.9
Eastern gray squirrel	442 (9.53)	121 (3.65)	10.04	100
Red squirrel	0	5 (0.15)	2.18	98.5
Other squirrel	0	6 (0.18)	2.47	99.3
Woodchuck	138 (2.97)	21 (0.63)	7.27	100
North American porcupine	0	2 (0.06)	0.95	82.8
Common muskrat	19 (0.41)	1097 (33.06)	41.33	100
American beaver	27 (0.58)	23 (0.69)	0.47	68
Domestic dog	491 (10.58)	212 (6.39)	6.45	100
Wolf	0	0	-	-
***Canis* sp.**	41 (0.88)	62 (1.87)	3.75	100
Red fox	0	1 (0.03)	0.16	56.5
Common gray fox	5 (0.11)	0	1.48	93
Other canid	1 (0.02)	11 (0.33)	3.22	99.9
Black bear	100 (2.16)	10 (0.30)	6.91	100
Northern raccoon	328 (7.07)	188 (5.67)	2.46	99.3
Striped skunk	0	0	-	-
Mustelid	33 (0.71)	8 (0.24)	2.73	99.7
***Lynx* sp.**	1 (0.02)	10 (0.30)	3.01	99.9
Other carnivore	21 (0.45)	32 (0.96)	2.62	99.6
Total	4640	3318	-	-

Note: The value in parenthesis (n=) at the top of the column represents the number of sites included in the calculation. The value in parenthesis in the row represents the % of NISP for the listed species and families. Cervid = deer family, leporid = rabbit or hare, canid = dog family, mustelid = northern river otter, long-tailed weasel, American marten, or American mink. One-tailed % confidence level values are reported. The following categories were not included in the analyses: white-footed mouse, deer mouse, *Peromyscus* sp., murid, meadow vole, vole, house mouse, meadow jumping mouse, small rodent, small to medium rodent, medium rodent, medium to large rodent, large rodent, rodent, northern short-tailed shrew, star-nosed mole, hairy-tailed mole, mole, small mammal, small to medium mammal, medium mammal, medium to large mammal, large mammal, mammal.

Table 3.5 Continued

Taxon	Iroquoian A.D. 800-1200 (n=12)	Iroquoian A.D. 1200-1600 (n=28)	Z-value	% Confidence Level
White-tailed deer	12395 (80.69)	9638 (56.43)	46.73	100
Elk	2 (0.01)	315 (1.84)	16.67	100
Moose	1 (0.01)	22 (0.13)	3.85	100
Other cervid	154 (1.00)	1271 (7.44)	28.23	100
Eastern cottontail	40 (0.26)	128 (0.75)	6.06	100
Snowshoe hare	16 (0.10)	53 (0.31)	3.98	100
Other leporid	15 (0.10)	14 (0.08)	0.42	66.1
Eastern chipmunk	163 (1.06)	344 (2.01)	6.84	100
Eastern gray squirrel	807 (5.25)	1087 (6.36)	4.23	100
Red squirrel	44 (0.29)	112 (0.66)	4.73	100
Other squirrel	1 (0.01)	18 (0.11)	3.49	100
Woodchuck	194 (1.26)	759 (4.44)	16.90	100
North American porcupine	17 (0.11)	16 (0.09)	0.39	65.2
Common muskrat	59 (0.38)	541 (3.17)	18.58	100
American beaver	342 (2.23)	438 (2.56)	1.90	97.1
Domestic dog	273 (1.78)	755 (4.42)	13.52	100
Wolf	3 (0.02)	35 (0.20)	4.57	100
***Canis* sp.**	10 (0.07)	462 (2.71)	19.78	100
Red fox	5 (0.03)	93 (0.54)	8.26	100
Common gray fox	2 (0.01)	20 (0.12)	3.59	100
Other canid	8 (0.05)	86 (0.50)	7.43	100
Black bear	206 (1.34)	364 (2.13)	5.37	100
Northern raccoon	455 (2.96)	336 (1.97)	5.74	100
Striped skunk	1 (0.01)	36 (0.21)	5.16	100
Mustelid	69 (0.45)	109 (0.64)	2.24	98.7
***Lynx* sp.**	39 (0.25)	14 (0.08)	3.65	100
Other carnivore	41 (0.27)	13 (0.08)	4.06	100
Total	15362	17079	-	-

Cervid hunting and processing was clearly one of the most important late prehistoric subsistence activities in southwestern Ontario. Both traditions, however, appear to have redirected some of their hunting efforts to smaller mammals over time (Figure 3.5; Table 3.5). Table II in Appendix D and Table 3.5, illustrate a significant decrease (α=0.01) in the procurement of cervids, primarily white-tailed deer, and raccoon by Western Basin and Iroquoian peoples between the early and late periods of occupation. It is accompanied by a significant increase (α=0.01) in the hunting and trapping of aquatic rodents, primarily muskrat, as well as rabbits and hares (leporids). After A.D. 1200, the Western Basin procurement of woodchuck and members of the squirrel family significantly

decreased (α=0.01). In contrast, members of the Iroquoian community increased their exploitation of these animals, as well as chipmunk, red fox, and skunk.

A number of changes are also observed in Western Basin and Iroquoian fishing practices between A.D. 800 and 1600. After A.D. 1200 both communities intensified their fishing activities. This involved the exploitation of a greater number of species (Table 3.6), and as is demonstrated in Figure 3.6, a significant shift (α=0.01; Appendix D: Table III) in the fish families targeted from the early to the late periods. Between A.D. 800 and 1600, Western Basin and Iroquoian communities significantly decreased (α=0.01) their exploitation of suckers and increased their procurement of perch-like fish (perciformes), pikes (esocids), bowfin, and catfish (ictalurids). Western Basin people also emphasized salmon (salmonid) family fishing after A.D. 1200, targeting lake whitefish and cisco/lake herring. Iroquoians minimally, yet consistently, exploited salmonids during the 800 years of interest (Table 3.6).

Table 3.6 identifies other modifications to these culture-specific fishing strategies over time. A significant shift (α=0.01) in Western Basin perch-like fish exploitation is observed between the early and late periods of occupation. Groups switched from the fishing of walleye/sauger and yellow perch (percids) to that of sunfish and freshwater drum. These people also decreased burbot procurement over time while simultaneously increasing lake sturgeon fishing (α=0.01). In comparison, neighbouring Iroquoian groups exploited a greater variety of fish species between A.D. 800 and 1600. During this period, they notably increased their exploitation of yellow perch (α=0.01).

Table 3.6. Identified fish species and families from southwestern Ontario sites, A.D. 800-1600

	Western Basin			
Taxon	A.D. 800-1200 (n=6)	A.D. 1200-1600 (n=5)	Z-value	% Confidence Level
Sunfish	74 (1.74)	218 (6.30)	10.38	100
Freshwater drum	83 (1.95)	125 (3.61)	4.41	100
Walleye/sauger	1221 (28.70)	554 (16.00)	13.16	100
Yellow perch	200 (4.70)	43 (1.24)	8.59	100
Other percid	60 (1.41)	21 (0.61)	3.32	100
Other perciformes	23 (0.54)	411 (11.87)	21.44	100
***Catostomus* sp.**	66 (1.55)	18 (0.52)	4.23	100
***Moxostoma* sp.**	13 (0.31)	3 (0.09)	1.86	96.9
Other catostomid	2131 (50.08)	72 (2.08)	46.41	100
Pike	0	44 (1.27)	7.22	100
Bowfin	4 (0.09)	661 (19.09)	29.54	100
Lake sturgeon	10 (0.24)	37 (1.07)	4.51	100
Brown bullhead	5 (0.12)	3 (0.09)	0.05	52.1
Channel catfish	10 (0.24)	11 (0.32)	0.45	67.4
Other ictalurid	43 (1.01)	141 (4.07)	8.69	100
Gar	0	1 (0.03)	0.15	55.8
Lake whitefish/herring	51 (1.20)	1012 (29.23)	35.50	100
Trout	0	2 (0.06)	0.92	82.1
Other salmonid	0	84 (2.43)	10.12	100
Burbot	261 (6.13)	1 (0.03)	14.65	100
American eel	0	0	-	-
Clupeiformes	0	0	-	-
Minnows/carps	0	0	-	-
Total	4255	3462	-	-

Note: The value in parenthesis (n=) at the top of the column represents the number of sites included in the calculation. The value in parenthesis in the row represents the % of NISP for the listed species and families. Perciformes = perch-like fish order, percid = walleye, sauger, or yellow perch, catostomid = sucker family, ictalurid = catfish family, salmonid = salmon family, clupeiformes = herring-like fish order. One-tailed % confidence level values are reported. The following categories were not included in the analyses: small fish, small to medium fish, medium fish, medium to large fish, large fish, fish.

Table 3.6 Continued

Taxon	Iroquoian A.D. 800-1200 (n=8)	Iroquoian A.D. 1200-1600 (n=27)	Z-value	% Confidence Level
Sunfish	93 (5.40)	818 (19.25)	13.45	100
Freshwater drum	11 (0.64)	56 (1.32)	2.13	98.3
Walleye/sauger	122 (7.08)	358 (8.43)	1.69	95.4
Yellow perch	9 (0.52)	93 (2.19)	4.40	100
Other percid	3 (0.17)	44 (1.04)	3.29	99.9
Other perciformes	0	19 (0.45)	2.54	99.5
***Catostomus* sp.**	701 (40.68)	260 (6.12)	32.89	100
***Moxostoma* sp.**	126 (7.31)	128 (3.01)	7.39	100
Other catostomid	472 (27.39)	185 (4.35)	25.74	100
Pike	4 (0.23)	229 (5.39)	9.26	100
Bowfin	7 (0.41)	130 (3.06)	6.10	100
Lake sturgeon	11 (0.64)	74 (1.74)	3.13	99.9
Brown bullhead	25 (1.45)	1153 (27.14)	22.57	100
Channel catfish	24 (1.39)	85 (2.00)	1.49	93.2
Other ictalurid	46 (2.67)	380 (8.94)	8.47	100
Gar	1 (0.06)	20 (0.47)	2.18	98.6
Lake whitefish/herring	38 (2.21)	70 (1.65)	1.36	91.4
Trout	6 (0.35)	20 (0.47)	0.42	66.3
Other salmonid	6 (0.35)	17 (0.40)	0.05	52.1
Burbot	8 (0.46)	29 (0.68)	0.80	78.8
American eel	0	13 (0.31)	2.02	97.8
Clupeiformes	0	1 (0.02)	-0.56	28.7
Minnows/carps	10 (0.58)	67 (1.58)	2.98	99.9
Total	1723	4249	-	-

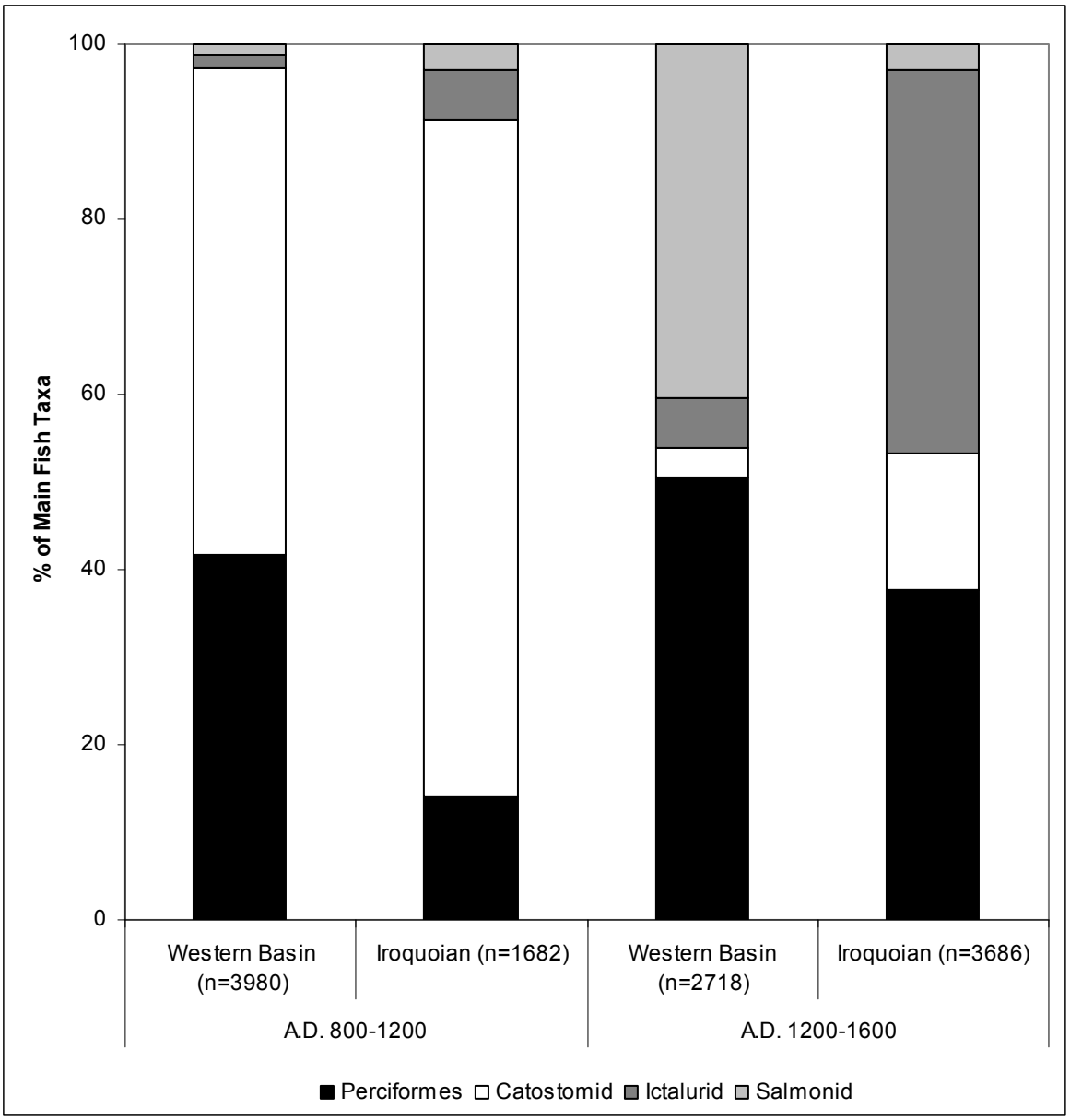

Figure 3.6. Main fish taxa representation for the A.D. 800-1200 and A.D. 1200-1600 periods. Perciformes = perch-like fish order, Catostomid = sucker family, Ictalurid = catfish family, Salmonid = salmon family.

Over time, significant shifts (α=0.01) in Western Basin and Iroquoian bird preferences are also observed (Table 3.7; Appendix D: Table IV). Within both groups, there is a significant decrease (α=0.01) in the exploitation of chicken-like (galliformes) birds, especially wild turkey, after A.D 1200. At the same time, members of both traditions significantly (α=0.01) intensified their exploitation of passenger pigeons and waterfowl (anatids). There was a greater emphasis on the former among Iroquoian communities and the latter among Western Basin communities.

Despite the broad similarities in faunal exploitation observed between the two groups during the 800 years of interest, there are also important differences. These are summarized in Tables V and VI in Appendix D and are outlined here. The data (Appendix D: Table V) clearly illustrate that throughout time, Western Basin peoples fished more intensively than Iroquoian groups, who instead placed a greater emphasis on mammal and bird hunting, and during the later period, the procurement of reptiles, amphibians, and invertebrates (α=0.01). From A.D. 800 to 1600, Western Basin groups exploited raccoon, walleye/sauger, and freshwater drum to a greater degree (α=0.01; Appendix D: Table VI), while neighbouring Iroquoians hunted more deer and harvested more suckers, catfish, and sunfish (α=0.01; Appendix D: Table VI).

Differences between the groups become even more pronounced during the later period. Between A.D. 1200 and 1600, in addition to the differences outlined above, Western Basin peoples exploited muskrat, bowfin, lake whitefish/herring, and waterfowl more intensively than neighbouring Iroquoian groups (α=0.01; Appendix D: Table VI). In contrast, Iroquoians procured comparatively more squirrel, woodchuck, and pike (α=0.01; Appendix D: Table VI).

Table 3.7. Identified bird species and families from southwestern Ontario sites, A.D. 800-1600

Western Basin

Taxon	A.D. 800-1200 (n=6)	A.D. 1200-1600 (n=5)	Z-value	% Confidence Level
Passenger pigeon	3 (2.54)	80 (30.30)	5.95	100
Other columbid	1 (0.85)	38 (14.39)	3.86	100
Wild turkey	72 (61.02)	10 (3.79)	12.45	100
Ruffed grouse	11 (9.32)	0	4.70	100
Other galliformes	1 (0.85)	1 (0.38)	-0.18	42.9
Swans, geese, and ducks	5 (4.24)	115 (43.56)	7.53	100
Loon	0	2 (0.76)	0.18	57.3
Grebe	0	2 (0.76)	0.18	57.3
Cormorant	0	1 (0.38)	-0.41	34
Woodpecker	0	0	-	-
Owl	14 (11.86)	12 (4.55)	2.40	99.2
Hawk	4 (3.39)	1 (0.38)	1.90	97.2
Cranes, coots, and rails	0	0	-	-
Great blue heron	1 (0.85)	0	0.42	66.2
Kingfisher	0	0	-	-
Perching birds	6 (5.08)	2 (0.76)	2.34	99
Total	118	264	-	-

Iroquoian

Taxon	A.D. 800-1200 (n=7)	A.D. 1200-1600 (n=27)	Z-value	% Confidence Level
Passenger pigeon	52 (22.32)	733 (57.67)	9.86	100
Other columbid	0	4 (0.31)	0.15	56.1
Wild turkey	114 (48.93)	116 (9.13)	15.42	100
Ruffed grouse	12 (5.15)	122 (9.60)	2.07	98.1
Other galliformes	9 (3.86)	12 (0.94)	3.19	99.9
Swans, geese, and ducks	16 (6.87)	160 (12.59)	2.39	99.1
Loon	2 (0.86)	7 (0.55)	0.10	54.1
Grebe	2 (0.86)	3 (0.24)	0.89	81.4
Cormorant	0	0	-	-
Woodpecker	2 (0.86)	9 (0.71)	-0.17	43.2
Owl	6 (2.58)	21 (1.65)	0.71	76.3
Hawk	8 (3.43)	15 (1.18)	2.28	98.9
Cranes, coots, and rails	1 (0.43)	36 (2.83)	1.94	97.4
Great blue heron	0	1 (0.08)	-0.95	17.2
Kingfisher	0	1 (0.08)	-0.95	17.2
Perching birds	9 (3.86)	31 (2.44)	1.02	84.5
Total	233	1271	-	-

Note: The value in parenthesis (n=) at the top of the column represents the number of sites included in the calculation. The value in parenthesis in the row represents the % of NISP for the listed species and families. Columbid = pigeon or dove, galliformes = chicken-like bird order. One-tailed % confidence level values are reported. The following categories were not included in the analyses: hawk or owl, heron or crane, alcid, greater yellowlegs, small to medium aquatic bird, medium aquatic bird, medium to large aquatic bird, large aquatic bird, small bird, small to medium bird, medium bird, medium to large bird, large bird, bird.

Discussion

Despite the shortcomings of the assembled datasets, this study develops a much-needed baseline for reconstructing southwestern Ontario culture-specific hunting and fishing practices between A.D. 800 and 1600. Although the model proposed here will likely change as additional sites are excavated and analyzed in the coming years, it provides an up-to-date summary of past faunal procurement strategies in the region.

Shared Trends in Faunal Exploitation

Between A.D. 800 and 1600 Western Basin and Iroquoian communities diversified their faunal procurement strategies. Several significant shifts in emphasis occurred and many species that were marginal in the early assemblages began to be represented in larger quantities during the later period. Perhaps most important in both traditions was the decrease in white-tailed deer hunting, which was offset by an intensified procurement of smaller-bodied mammals, fish, and birds, as well as other small animals including reptiles and amphibians. Both groups also reduced their sucker fishing over time, with a corresponding increase in the exploitation of perch-like fishes (especially sunfish), pike, bowfin, and catfish. The data indicate that suckers, sunfish, and catfish were always more important among Iroquoian communities than Western Basin ones. Bird hunting shifted away from turkeys to passenger pigeons and waterfowl. These parallel changes in Western Basin and Iroquoian animal exploitation are best explained by scheduling conflicts and labour reorganization associated with agricultural intensification.

Both macro-botanical (e.g., Crawford et al. 1997, 2006) and stable isotopic evidence (e.g., Dewar et al. 2010; Harrison and Katzenberg 2003; Katzenberg et al. 1995; Schwarcz et al. 1985; Watts et al. 2011) suggest that Ontario's Western Basin and Iroquoian groups had incorporated domestic plant crops into their subsistence economies by A.D. 800 and A.D. 500, respectively. Maize, squash, sunflower, and beans initially supplemented locally available plant and animal resources (Ferris 1999:29), but over time, these storable domesticates were

produced in greater quantities. For Iroquoian groups, maize composed a substantial part of the diet from A.D. 1000 onwards (Harrison and Katzenberg 2003:241; Katzenberg 2006:270). While researchers recognize the importance of examining stable carbon isotopic changes between A.D. 500 and 1600 in order to document the overall contribution of maize to the Western Basin diet, the limited availability of samples has hampered investigations. Recent results (Dewar et al. 2010; Watts et al. 2011) suggest, however, that members of this community similarly increased their consumption of domestic crops in the second millennium A.D. The zooarchaeological record indicates that these subsistence changes made it difficult to continue earlier patterns of faunal exploitation, forcing both groups to seek alternatives.

Scheduling of subsistence activities would have been most difficult from the early spring until the fall when efforts had to be divided between agriculture, hunting, fishing, and collecting. In the spring, usually sometime between April and May (see Ferris 1989b:111, 178, 179, 2006:140, 146, 147, 2009:42, 43, 47; Tooker 1967:71), gardens and fields had to be prepared and planted. If there was a late frost, crops had to be replanted. It was also during this time that Western Basin peoples and Iroquoians traditionally captured early spawning fish. Suckers, walleye/sauger, and yellow perch, can be procured in large numbers between April and June when they move to the shallow areas of lakes or up streams and rivers to spawn (Scott and Crossman 1998).

The significant decrease in sucker fishing by members of both traditions, and a reduced emphasis on walleye/sauger and yellow perch fishing by Western Basin peoples after A.D. 1200 suggests a less focused and less formal spring fishery than that observed during the early period. This likely reflects a redistribution of labour in order to ensure the successful acquisition of plant and animal resources for consumption over both the short- and long-term. Hunting, fishing, and planting efforts were divided among the groups/communities, enabling them to take advantage of larger catchment areas and the broad range of aquatic and terrestrial species available within them, such as muskrat, rabbits/hares, fish, migratory birds, reptiles, amphibians, and invertebrates.

Crops required tending and protection from the time of planting until the harvest (Ferris 1999:31). The effort involved was probably minimal, permitting the continued pursuit of traditional hunting and fishing activities throughout the warm season. This included the procurement of small to medium mammals and a variety of fish. By early fall, however, scheduling conflicts once again arose. Harvesting, processing, and storing of domesticates required a lot of time and labour; the larger the gardens and fields, the greater the amount of work required to prepare and store crops for the winter months.

The timing of the harvest probably varied slightly from year-to-year based on local climatic conditions. Ethnohistoric records (see Ferris 1989b:181, 182; Tooker 1967:61) indicate that this event generally took place in September and October, and coincided with the beginning of the nut collecting, white-tailed deer, and wild turkey hunting seasons. These three activities likely occurred simultaneously within dense pockets of nut-bearing trees surrounding the Western Basin and Iroquoian settlements. It is common knowledge that white-tailed deer favour acorns (Kurta 1995:266), and that these nuts also compose a major portion of the wild turkey fall diet (Sandilands 2005:159). Even if they were not collected by Western Basin and Iroquoian peoples, given their historic use as starvation food (Ojibwa: Ferris 1989b:109-110; Huron: Tooker 1967:61), a range of other nuts, including black walnuts, butternuts, hickory nuts, chestnuts, beechnuts, and hazelnuts, would have been available nearby. Nut remains have been recovered at numerous sites, such as Sibelius, Dymock, Cherry Lane, Sherman, Porteous, Kelly, Calvert, Crawford Lake, Pipeline, and Finch, which demonstrates their importance to late precontact southwestern Ontario subsistence economies.

The zooarchaeological record illustrates that between A.D. 800 and 1200 the hunting of white-tailed deer, and to a lesser extent, wild turkey, were important Western Basin and Iroquoian activities (Tables 3.4 and 3.6; Appendix D: Table VI). These animals were available year-round and were likely procured in the fall alongside raccoon, eastern chipmunk, and eastern gray squirrel, species that also favour nuts and inhabit deciduous forests with large stands of

walnut, hickory, maple, oak, and beech (Kurta 1995:114, 125, 219, 221; Reid 2006: 209, 210, 226, 227). The significant decrease in Western Basin and Iroquoian white-tailed deer, raccoon, and wild turkey procurement and the reduced Western Basin exploitation of chipmunks and eastern gray squirrels after A.D. 1200 suggests less intensive fall hunting compared to the early period. Again, it appears that labour was divided, this time between hunting and the harvesting of crops, resulting in a much more informal, opportunistic approach to faunal exploitation within both groups. This would also account for the increased hunting of muskrat, leporids, passenger pigeons, and waterfowl, fishing of perciformes, pikes, bowfin, and catfish, and collection of reptiles, amphibians, and invertebrates.

Together these data suggest that Western Basin and Iroquoian faunal procurement became less specialized, more informal, and likely more opportunistic between A.D. 800 and 1600. The observed diversification is notable during the second millennium A.D. and most likely reflects scheduling conflicts and a reorganization of labour associated with the increased importance of domestic crops to their subsistence economies. A reduction in the availability of preferred animal species, whether due to climatic variations, changing habitat conditions, overexploitation, or various combinations of these, would result, however, in a similar interpretation. It is suggested here, that although species availability likely influenced the observed changes in Late Woodland faunal procurement practices, the effects were probably not equally observed throughout the region, and for several species at the same time. As such, the noted shifts in Western Basin and Iroquoian hunting and fishing activities, which increasingly emphasized the variety of terrestrial and aquatic animals that could be obtained near their settlements, especially during the spring and fall, best reflect scheduling conflicts associated with agricultural intensification.

Distinct Traditions of Faunal Exploitation

Despite the shared trends in faunal exploitation discussed above, there are also marked differences between the two archaeological traditions that help to elucidate their interactions with and views of the southwestern Ontario

environment. One of the most important distinctions throughout the 800 years of interest was the emphasis placed on fishing by Western Basin peoples compared to their Iroquoian neighbours. Fish accounted for 23.82% and 41.07% of the identified Western Basin specimens in the early and late period assemblages, respectively (Figure 3.4). These values are significantly higher than the contemporaneous 8.53% and 27.02% observed for the Iroquoian datasets, and suggest a much stronger Western Basin tie to aquatic environments.

The range of fish species identified from Western Basin contexts (Table 3.6) implies that these peoples fished in a variety of habitats over the course of the year. Between A.D. 800 and 1200, Western Basin fishers targeted spring spawning suckers, walleye/sauger, and yellow perch along lakeshore shallows and near river mouths and rapids, as well as late spring to early summer spawning sunfish and catfish in ponds and streams. They also exploited summer spawning freshwater drum in river and lake shallows and winter spawning burbot along the lakeshores (Scott and Crossman 1998). While the early spring fishery continued into the A.D. 1200 to 1600 period, the time and effort devoted to it was significantly decreased, and emphasis was instead placed on the warm season fishing of sunfish, freshwater drum, catfish, bowfin, and pike. Also during the late period, Western Basin peoples appear to have incorporated the fall salmonid fishery into their subsistence economy. This is an excellent example of late period diversification of faunal procurement and is likely associated with the increased time and effort required for crop harvesting. These salmonids, lake whitefish/herring and lake trout, spawn from late September to December in the shallows of lakes or at the headwaters of streams where they can easily be procured in large numbers (Scott and Crossman 1998).

The fish data also suggest that the intensity of Western Basin fishing activities varied with season and location. People likely fished from the St. Clair, Detroit, Ausable, Sydenham, and Thames rivers and their tributaries throughout the warm season, with the greatest concentration of activities during the early spring (for suckers and walleye/sauger). In comparison, fishing was a year-round enterprise along the shores of Lake St. Clair and Lake Erie. It appears that

Western Basin fishers more intensively exploited lake dwelling species, including walleye/sauger, yellow perch, freshwater drum, lake whitefish/herring, lake trout, and burbot, than their Iroquoian neighbours.

In contrast to the Western Basin community, fishing was a more opportunistic activity for Iroquoians. While spring, summer, and fall (possibly also winter) trips to the lakeshores were common, as is evidenced by the Upper Bluff Pond site and as has been noted for Iroquoian Late Woodland archaeology in southern Ontario (e.g., Dodd et al. 1990; Lennox and Fitzgerald 1990; Williamson 1990), the abundance of sunfish, walleye/sauger, sucker, pike, bowfin, and catfish in these assemblages suggests that fishing predominantly occurred in the streams, creeks, and ponds near the settlements. Fishing took place from the spring until the fall, and appears to have targeted species during spawning. Some groups, such as the middle Iroquoians occupying the Moatfield site near Toronto, consumed larger proportions of freshwater fish than others (van der Merwe et al. 2003a, b), again demonstrating the localized nature of Late Woodland faunal procurement practices. Between A.D. 800 and 1200 Iroquoian peoples concentrated their fishing activities on the spring sucker and walleye/sauger fishery and the warm season catfish fishery. While the spring fishery was maintained into the late period, the number of fish captured significantly decreased and emphasis shifted instead to the general warm season procurement of sunfish, catfish, pike, and bowfin. During the 800 years of interest, Iroquoian fishing practices broadened to include a greater number of species, while simultaneously emphasizing the procurement of those within the immediate environment. It appears that most Iroquoian groups in southwestern Ontario spent more time and effort hunting terrestrial mammals and birds than fishing.

During both the early and late periods, Iroquoians also hunted cervids more intensively than Western Basin peoples (early: Western Basin = 62.87%, Iroquoian = 81.71%; late: Western Basin = 43.97%, Iroquoian = 65.84%; Table 3.5). Cervid procurement was the primary faunal exploitation focus of this tradition throughout the year. While other mammals including both terrestrial and

aquatic rodents, canids, and other carnivores were consistently hunted, they merely supplemented the cervids. Of particular interest is the increased procurement of chipmunks, squirrels, woodchuck, and skunks after A.D. 1200. Domestic crops, whose production was increased during the second millennium A.D., would have also served as a food source for these animals, drawing them to both the fields and the stores in the villages. It is therefore very likely that the local availability of these species improved with agricultural intensification, and that their increased numbers in the Iroquoian zooarchaeological record may not only reflect faunal procurement activities situated closer to home, but also the eradication of pests.

Curiously, Western Basin squirrel family procurement was significantly reduced during the same period, a pattern that may relate to the small Western Basin sample size. During both periods, however, Western Basin peoples hunted a greater proportion of raccoon (early: Western Basin = 7.07%, Iroquoian = 2.96%; late: Western Basin = 5.67%, Iroquoian = 1.97%; Table 3.5). This species occupies a variety of microenvironments within southwestern Ontario and also favours maize. It would have been available to hunters in all identified settlement locales.

After A.D. 1200, muskrat began to be intensively procured by both Western Basin and Iroquoian peoples. The Western Basin procurement, however, is over ten times that of the Iroquoian (Western Basin = 33.06%, Iroquoian = 3.17%; Table 3.5), suggesting that it was a specialized activity. The three sites (i.e., Liahn I, Libby, Dobbelaar) from which these remains were recovered are clustered near the St. Clair River delta, an area that has been favoured for muskrat hunting from the late Archaic (Thomas 1988) through to the historic periods (Ferris 1989b:102).

Waterfowl were also extensively exploited within this area during the late period and account for nearly half (43.56%; Table 3.7) of all identified bird remains at Western Basin sites. While Iroquoians also more intensively hunted swans, geese, and ducks after A.D. 1200 (early = 6.87%, late = 12.59%; Table 3.7), these people preferred to target the passenger pigeon. Passenger pigeon

specimens represent 57.67% of all identified bird specimens further supporting the suggested terrestrial orientation of Iroquoian hunters.

The observed patterns of faunal exploitation between the two groups indicate distinct uses of their shared southwestern Ontario environment. Together, the fish, mammal, and bird datasets suggest that Late Woodland Western Basin peoples were much more mobile than contemporary Iroquoians. Throughout the year, but especially during the warm season, Western Basin settlements were situated near riverine and/or lacustrine environments where a variety of aquatic and terrestrial animals could easily be procured. It appears that groups frequently moved between these settlements, timing their occupations in order to exploit seasonally abundant species. This is exemplified by the recovery of lake-dwelling fish, aquatic rodents, and waterfowl at sites located a distance from the shores of lakes and major rivers. The Western Basin procurement strategy focused on the hunting, collection, processing, transport, and storage of seasonally abundant animal resources to augment domestic crops and other edible plants.

In comparison, southwestern Ontario Iroquoian groups primarily hunted and fished species available near their settlements to supplement the domestic crops. Terrestrial animals are much better represented in their assemblages than aquatic ones, reflecting a more land-based approach to faunal exploitation. While all of the main classes were represented, mammals, especially cervids were the focus of hunting efforts. Between A.D. 800 and 1600, Late Woodland hunters probably did not have to travel extensively in order to successfully procure their prey in the Carolinian forest of southwestern Ontario. The abundance of these animals might have influenced some, like the Iroquoians, to occupy their settlements for longer periods of each year over time (i.e., several decades).

Conclusion

By controlling for time period and geographic region, this study has pinpointed how two neighbouring archaeological traditions exploited the available animal resources within southwestern Ontario. Western Basin and Iroquoian

hunters diversified their procurement strategies between A.D. 800 and 1600. The observed reduction in white-tailed deer exploitation, and the associated increase in fishing, bird hunting, and the collection of reptiles, amphibians, and invertebrates is best explained by scheduling conflicts and labour reorganization associated with increased domestic crop production. With more effort being devoted to the planting, tending, harvesting, and storing of plant crops, less time and labour was available for the spring fishery and the hunting of white-tailed deer and wild turkey in the fall.

The zooarchaeological evidence also records important differences between the groups, with Western Basin peoples devoting more energy to fishing overall, and concentrating more on lake-dwelling species, including the percids, salmonids, and burbot, while Iroquoians emphasized riverine species, such as suckers, catfish, and pike. Other researchers (Murphy and Ferris 1990) have suggested that Western Basin groups were more seasonally mobile than their Iroquoian contemporaries, and the fish, mammal, and bird data assembled here support this assertion.

The Western Basin community had a strong tie to the lakes and waterways of southwestern Ontario that is not paralleled in the Iroquoian dataset. Fish were an important Western Basin resource requiring seasonal and annual travel for their successful procurement. While Iroquoian groups also travelled to exploit their preferred species, hunting and fishing emphases appear to have been placed on resources that were available within the immediate environment, especially during the later period of occupation.

This study represents an initial attempt to synthesize and compare the Western Basin and Iroquoian zooarchaeological datasets from southwestern Ontario. The identification of new sites in the future will allow for further testing of the observed trends and finer temporal resolution that will help provide a more nuanced understanding of animal exploitation over time.

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CHAPTER IV

UBIQUITOUS FRAGMENTED FAUNA: INTERPRETING WESTERN BASIN CERVID PROCESSING AND DISCARD PRACTICES, A.D. 800-1600

A main goal of taphonomic research in zooarchaeology is to distinguish between the impacts of natural and cultural processes in the formation of archaeofaunal assemblages. Work by a number of scholars (e.g., Outram 1998, 2001, 2002, 2004a, b; Outram et al. 2005; Prince 2007) has demonstrated that careful attention to the indeterminate or unidentifiable portion of a dataset can allow us to make this distinction. Documenting a suite of taphonomic markers, including the presence and degree of burning and weathering, enables the characterization of formation processes and the precise reconstruction of assemblage fragmentation. This study demonstrates the potential for such an approach in the investigation of extensively fragmented large mammal remains (Figure 4.1) commonly recovered from Late Woodland Western Basin contexts in southwestern Ontario.

Throughout the Northeast, cervid specimens dominate both precontact and historic native zooarchaeological assemblages, indicating that these species were the most sought-after mammals. White-tailed deer (*Odocoileus virginianus*), and to a lesser degree elk (*Cervus elaphus*) provided a variety of resources including meat, fat, marrow, skins, and raw materials for the production of tools and other objects used by these cultures. Between A.D. 500 and 1600 the Western Basin peoples of the lower Great Lakes region practiced a mixed subsistence economy, combining the production of domestic crops with hunting, fishing, and gathering of local animal and plant resources (Murphy and Ferris 1990). The cervid remains recovered from their sites are consistently highly fragmented. This study attempts to identify the cause(s) of this fragmentation in four southwestern Ontario assemblages dating between A.D. 800 and 1600. Following a method outlined by Outram (1998, 2001) it examines both the

identifiable and unidentifiable large mammal remains by fragment size, bone type, presence of burning, and degree of weathering. Combined with information about long bone fracture angle, outline, and edge texture, these data enable the researcher to determine when (i.e., before or after deposition and burial) the specimens were fragmented, and to infer the natural and cultural processes that produced them.

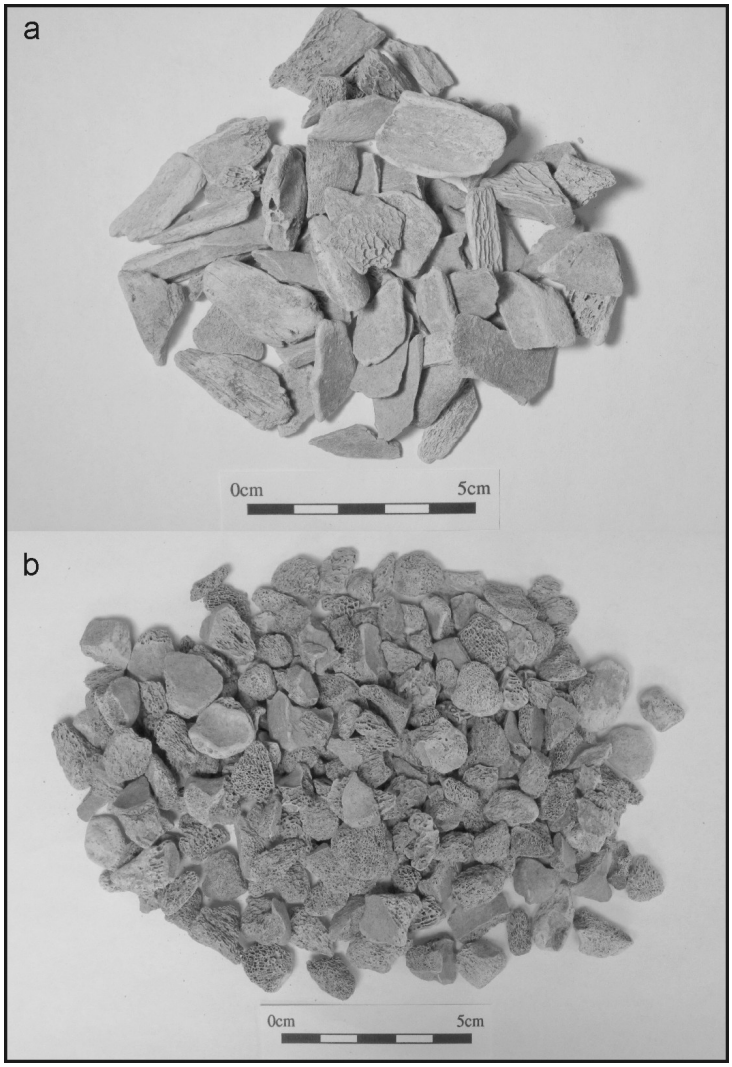

Figure 4.1. a) Cortical long bone (20-30 mm) and b) indeterminate cancellous bone (0-20 mm) fragments recovered from Feature 16 at the Montoya site.

Together the evidence indicates that the vast majority of skeletal elements were fractured when fresh and that cervid bone marrow and grease played a pivotal role in Western Basin cuisine. Their year-round extraction over an 800-year period suggests taste preferences and a tradition of using bone grease in food preparation as the primary cause. This stands in contrast to explanations for within-bone nutrient extraction based on food stress, that are prevalent in the archaeological and ethnographic literature of hunter-gatherer groups (e.g., Binford 1978:166; Blumenschine and Madrigal 1993; Logan 1998; Munro and Bar-Oz 2005; Outram 1998, 2001, 2002, 2004a, b; Yellen 1991).

A Brief History of Within-Bone Nutrient Studies

The zooarchaeological study of bone marrow and grease extraction began during the 1960s and 70s and was complemented by ethnoarchaeological research on the hunting and butchering practices of contemporary hunter-gatherers (e.g., Binford 1978; Burch 1972; Spiess 1979; Zierhut 1967). In pursuing this work, researchers have attempted to understand how and why the faunal remains recovered from so many archaeological contexts were deliberately fragmented. While within-bone nutrients are commonly collected from a variety of mammals, worldwide they are most intensively sought from ungulates, many of which have been and continue to be of great economic importance to human populations. To date, North American researchers have emphasized the study of prehistoric bone marrow and grease extraction from bison (*Bison bison*) (Brink 1997; Kooyman 2004; Logan 1998; Vehik 1977; Zierhut 1967) and white-tailed deer (Church and Lyman 2003; Madrigal 2004; Madrigal and Capaldo 1999; Madrigal and Holt 2002).

The breaking of bones to extract the marrow and grease in their internal cavities is the final stage of the butchering process (Yellen 1991:23). Bone marrow is located within the medullary cavity of long and short bones of the appendicular skeleton and the body of the mandible (Outram 2004a:75). It is easily removed by first exerting force on the exterior to break the bone open, then by using a long, thin implement to poke the marrow out (Zierhut 1967). This process generally occurs when the bone is still fresh (within several days or a

few weeks following the kill), resulting in spiral or helical fractures along the shaft of the bone (Kooyman 2004; Outram 1998, 2001, 2002). Given that marrow and fat are metabolized in the distal elements (i.e., metacarpals, metatarsals) last, these are usually the first ones targeted by humans (Bar-Oz and Munro 2007:948; Blumenschine and Madrigal 1993:558-559).

Bone grease, located in the cavities of all bone types, is preferentially processed from the spongy ends of the long bones and the bones of the axial skeleton (Outram 2002:5, 2004a:75-76). Some groups, however, also collect the grease of the cortical long bone shafts. In order for efficient extraction, the skeletal elements are crushed into small fragments and placed in a container full of water to boil. The grease floats to the water's surface, is skimmed off, and placed in another container to cool (Binford 1978:158, 159; Brink 1997:260; Burch 1972; Leechman 1951; Spiess 1979; Vehik 1977:171; Zierhut 1967). It may then be stored in a liquid, semi-solid, or solid form, depending on the type of grease extracted and the community's storage and transport practices (e.g., liquid in a skin bag, solid in the form of grease cakes).

While bone marrow is often removed without further processing of the carcass for bone grease, the converse is generally not observed; bones must be crushed to extract the grease, exposing the marrow, which is also collected. Numerous studies (e.g., Binford 1978; Leechman 1951; Logan 1998; Outram 1998, 2001, 2002, 2004a, b; Vehik 1977) have noted the high degree of fragmentation associated with bone grease removal, an activity that limits the ability to recognize previous methods of processing, including patterns of butchery and bone marrow recovery (Brink 1997:272). Mandibles, ribs, and vertebrae of the axial skeleton are usually exploited for their protein-rich red marrow and yellow grease, while long bones and their spongy ends are processed for fatty white marrow and grease (Binford 1978:32; Outram 2004a:76). Archaeological and ethnographic studies (Bar-Oz and Munro 2007; Binford 1978; Blumenschine and Madrigal 1993:558, 559; Brink 1997:260; Morin 2007; Munro and Bar-Oz 2005; Noe-Nygaard 1977; Outram 1998:17-19, 62; Vehik 1977:180) indicate that these activities are strongly influenced by cultural

preferences and practices, the season, the animal's health, age, size, and sex, and whether or not the community is experiencing food stress.

The processing of within-bone nutrients is time and labour intensive, but can be conducted in an organized and efficient manner (Binford 1978) and is not as difficult as some researchers (e.g., Speth and Spielmann 1983:8, 12, 19) have implied. Most archaeologists (e.g., Binford 1978:158, 159; Munro and Bar-Oz 2005:224, 225) recognize that the extraction of bone grease requires more effort than the removal of bone marrow. Church and Lyman (2003) have recently demonstrated, however, that over 80% of total bone grease can be rendered from long bone fragments within a two to three hour period.

A worldwide survey of the ethnographic and archaeological literature confirms that bone marrow and grease extraction activities are generally associated with the seasonal or annual scarcity of fat or other resources, and indicate periodic subsistence-related stress among hunter-gatherer populations (Binford 1978:166; Blumenschine and Madrigal 1993; Logan 1998; Munro and Bar-Oz 2005; Outram 1998, 2001, 2002, 2004a, b; Speth 1990; Speth and Spielmann 1983; Yellen 1991). Brink (1997) and Prince (2007) are the only researchers who have recently used community/cultural preference to explain the intensive processing of medium to large terrestrial mammals for grease by such groups. Brink (1997:272) examined the ethnographic evidence describing Plains native subsistence activities and determined that the extraction of bone grease to make pemmican was vital to the economy. Similarly, Prince (2007) suggested that mammal grease was favoured over salmon oil by peoples living on the north coast of British Columbia between A.D. 640 and 1650.

Outram's (1998) pioneering research examining the indeterminate component of medium to large mammal assemblages has greatly improved our ability to assess the nature of prehistoric carcass processing activities. His work has enabled zooarchaeologists to determine the intensity of carcass processing activities, community preferences for certain types of marrow and grease, and to identify seasonal or decadal periods of food scarcity.

Materials and Methods

The Faunal Assemblages

The large mammal components of four southwestern Ontario Western Basin assemblages were analyzed to differentiate between natural and cultural causes of fragmentation and subsequently to reconstruct the cervid processing and disposal decisions made by members of this community between A.D. 800 and 1600. Faunal remains are typically recovered from pit features, and less frequently from middens at Western Basin sites. The pits, which vary in shape and size, litter the occupation surface and are located both within and outside of dwelling structures (Figures 4.2 and 4.3). It has been suggested (Murphy and Ferris 1990:236) that the majority were used for storing food resources such as nuts, domestic crops, and likely mammal and fish meat, as well as other material objects including ceramic vessels, hides, and skins, prior to their function as trash receptacles. This strategy suggests that late precontact groups in the lower Great Lakes relied heavily on seasonally available plant and animal foods.

As was noted above, southwestern Ontario's Western Basin peoples practiced a mixed subsistence economy during the 800 years of interest. They were highly mobile for an agricultural group, moving seasonally between settlements located near the shores of rivers and lakes to those located within the interior of the region in order to exploit locally abundant plants and animals (Chapter 2), not unlike Chilton's (1999) Late Woodland mobile farmers of southern New England. Year-round, faunal procurement focused on small to large mammals, including squirrels, raccoon, and cervids, as well as terrestrial birds, such as wild turkey and ruffed grouse. Intensive fishing complemented these activities from the early spring until the late fall.

Sites occupied between A.D. 800 and 1600 and representing both warm and cold season settlements are examined here (Figure 4.4). They include Montoya (Archaeologix Inc. 2004), Inland Aggregates West Location 12 (Archaeologix Inc. 2008), Liahn I (Kenyon 1988), and Dobbelaar (Neal Ferris, personal communication, 2006). All cultural deposits from these sites were

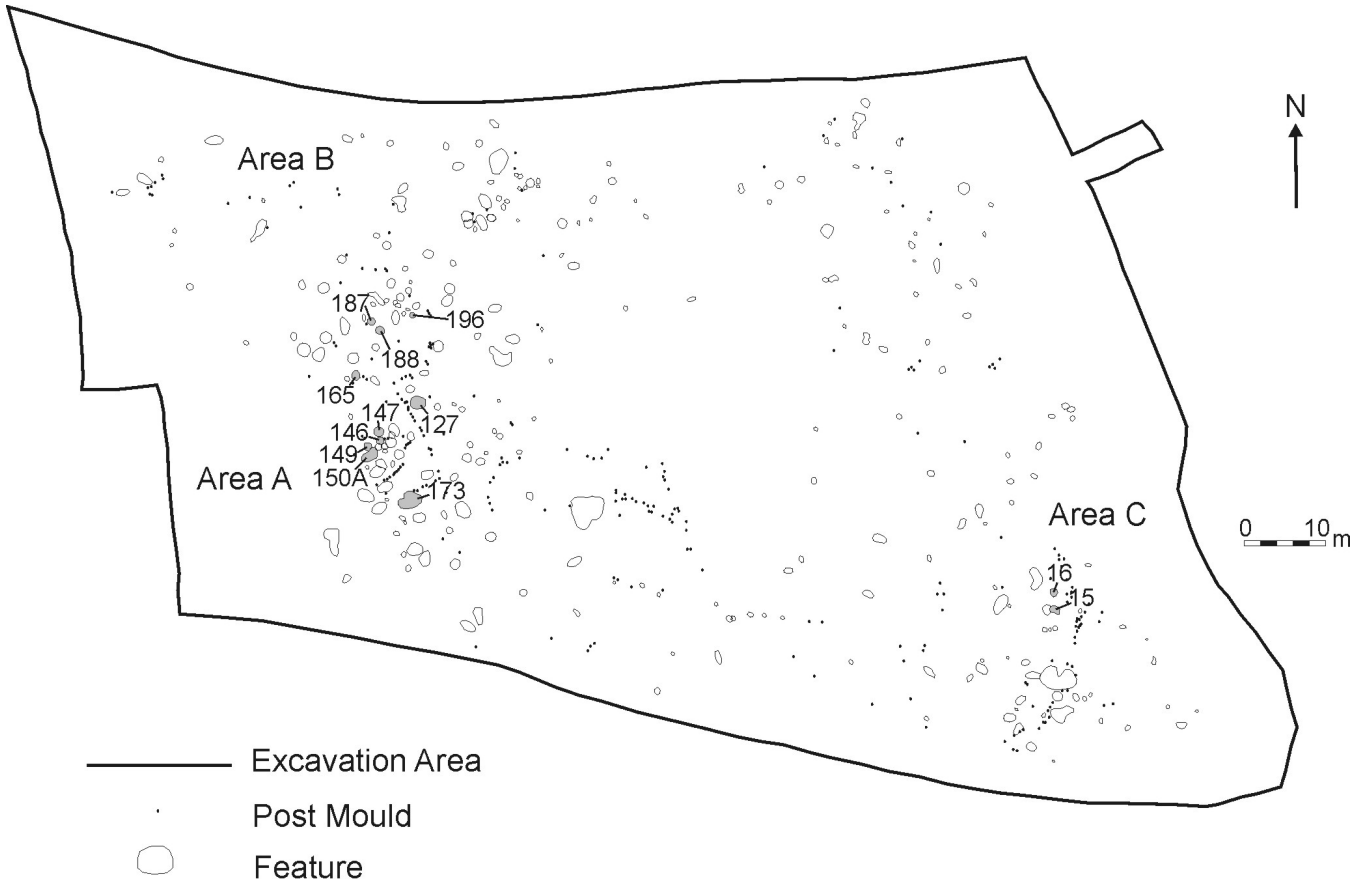

Figure 4.2. The Montoya site plan (Archaeologix Inc. 2004:34, Figure 19).

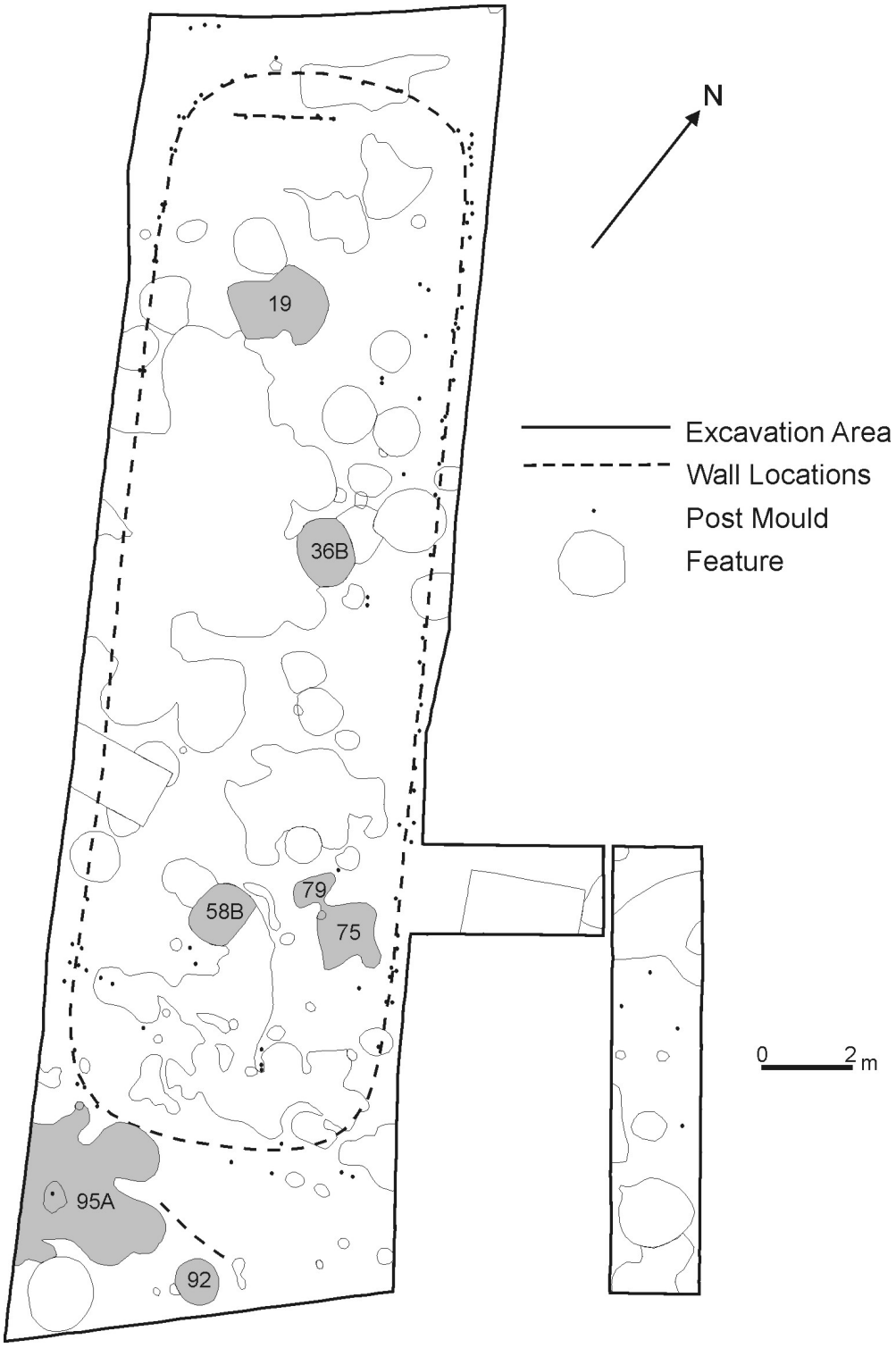

Figure 4.3. The Liahn I site plan (Kenyon 1988:7, Figure 5).

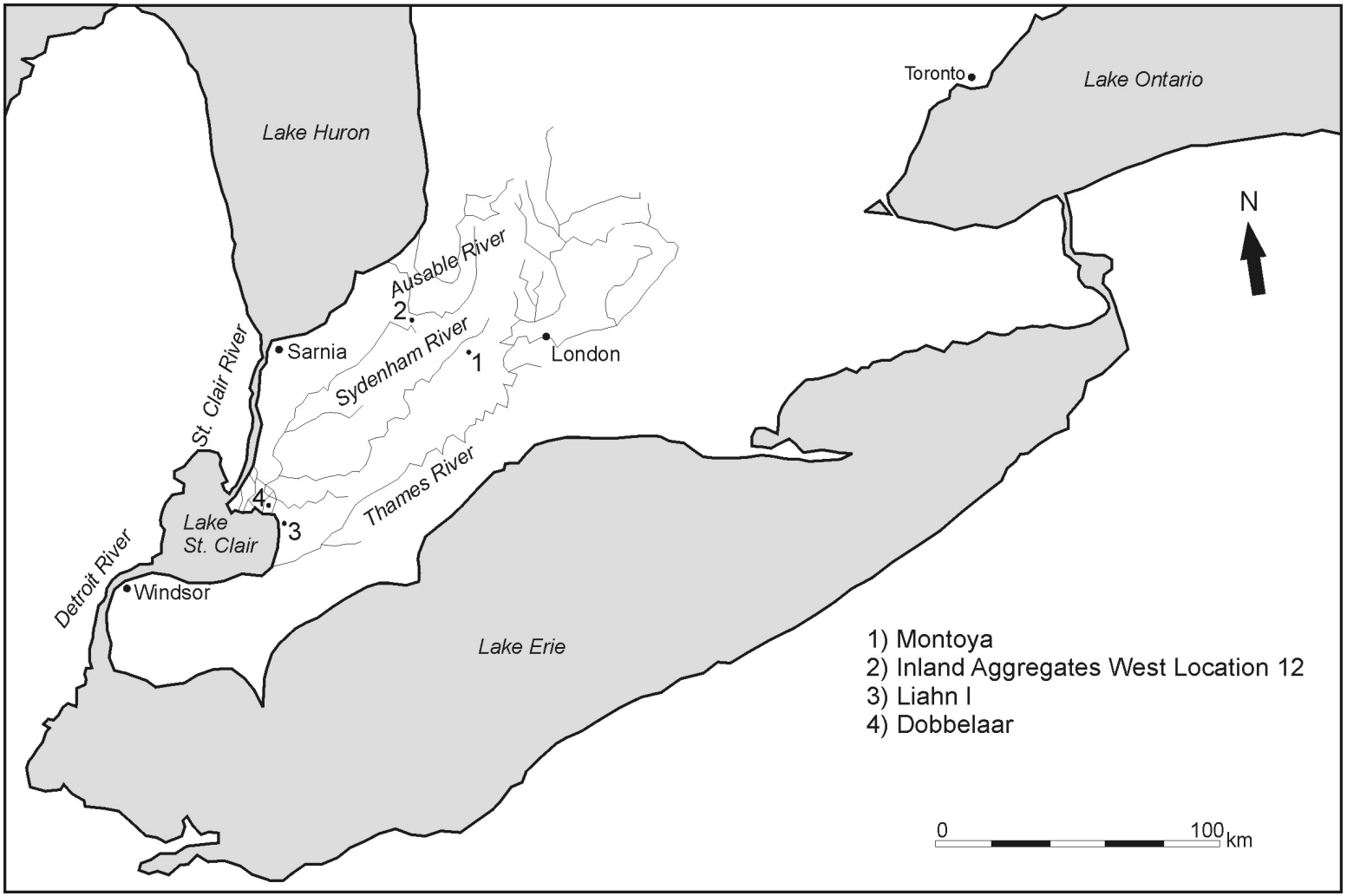

Figure 4.4. Western Basin site locations and major drainages in southwestern Ontario, A.D. 800-1600.

screened through 6 mm mesh and a portion of the feature fill was processed using flotation to recover all of the organic remains.

Archaeological evidence suggests that Montoya was a cold season early Western Basin settlement likely occupied between October and February. Analysis of the recovered fauna indicates that the hunting and processing of cervids was the primary exploitation focus at this site. An emphasis on cervid procurement is also suggested for the Inland Aggregates West Location 12 site, however the season during which hunting occurred is ambiguous. The available zooarchaeological data could support settlement during either the cold or the warm parts of the year. Further analyses are required to refine this estimate. At Liahn I, the faunal assemblage suggests periodic occupation throughout the year, with most intensive use of the site between May and October. Subsistence activities focused on muskrat hunting and bowfin fishing in the spring, fishing throughout the summer, and cervid hunting in the fall and possibly early winter. At the nearby Dobbelaar site, likely inhabited between March and October, fishing was the main faunal procurement activity, supplemented by muskrat and cervid hunting. Table 4.1 summarizes the characteristics of these assemblages.

Table 4.1. Summary of Western Basin site and assemblage characteristics

Site	Period of Occupation	Identified Assemblage	Large Mammal Component	% of Identified Assemblage	# of Features Examined	Season(s) Occupied
Montoya (AfHi-243)	ca. 800-1000 A.D.[1]	6127	5515	90.01	77	Cold
IAW 12 (AgHk-60)	1100±30 A.D. uncal	2275	2138	93.98	2	Cold, Warm?
Liahn I (AcHo-1)	1320±30 A.D. to 1550±60 A.D. uncal	12899	2045	15.85	32	Warm, Cold?
Dobbelaar	ca. 1400-1550 A.D.[1]	5187	150	2.89	15	Warm

[1] = date based on pottery attributes (seriation), assemblage sizes reported as number of identified specimens, IAW 12 = Inland Aggregates West Location 12.

Methods of Analysis

This study examines both the identifiable and unidentifiable components of the selected large mammal assemblages. Specimens assigned to the medium to large mammal, large mammal, and cervid categories were analyzed. Given the abundance of cervids in southwestern Ontario during the prehistoric and historic

periods, we can safely assume that the majority of the unidentifiable medium to large and large mammal remains resulted from the Western Basin butchering of white-tailed deer and elk. Every attempt was made to remove remains belonging to medium mammals, such as canids, and other large mammals, such as bears. It is possible, however, that the remains of these animals were included in the datasets. Because they are only present in small numbers in the identified components of these assemblages (Appendix A: Table II), it is safe to assume that these animals minimally contribute to the unidentified material and should not significantly influence the observed similarities and differences in cervid processing activities at the Montoya, Inland Aggregates West Location 12, Liahn I, and Dobbelaar sites.

Only those specimens recovered from feature contexts are included in the analysis. Such an approach enables the examination of natural and cultural taphonomic impacts, and subsequently of intra- and inter-site cervid processing activities and the extent of their variability within the Western Basin community. The Montoya and Liahn I assemblages were further studied to identify any observable patterns of bone marrow and grease extraction and waste disposal at the site level. Only those features containing a minimum of 100 large mammal specimens were examined in the intra-site analyses. Figures 4.2 and 4.3 illustrate the locations of the 19 selected features, which are also summarized in Table 4.2 along with descriptions of their use and size.

Following Outram (1998, 2001) the maximum dimension and mass of each specimen was recorded, as was the bone type, element, and portion of element (e.g. proximal, distal, centrum, epiphysis, shaft). Specimens were placed within the following size categories in order to examine the degree of assemblage fragmentation: 0-20 mm, 20-30 mm, 30-40 mm, 40-50 mm, 50-60 mm, 60-80 mm, 80-100 mm, and >100 mm. Outram (1998, 2001) recorded bone part (i.e., complete epiphyses) and whole bone measurements separately. As very few part or whole bones were identified in the Western Basin assemblages, here they were included in the appropriate size categories.

Table 4.2. Montoya and Liahn I large mammal specimen concentrations by feature

Assemblage	Feature	NISP	Location	Feature Type	Plan	Profile	Length (cm)	Width (cm)	Depth (cm)
Montoya	15	116 (2.10)	Area C	hearth	oval	shallow basin	130	120	20
	16	1615 (29.28)	Area C	pit	circular	layered basin	100	100	70
	127	855 (15.50)	Area A	pit	oval	basin	205	168	53
	146	148 (2.68)	Area A	pit	circular	cylindrical	120	102	65
	147	294 (5.33)	Area A	pit	circular	layered basin	105	105	45
	149	110 (1.99)	Area A	pit	circular	basin	50	50	30
	150A	346 (6.27)	Area A	pit	circular	layered cylindrical	170	120	70
	165	277 (5.02)	Area A to B	pit	circular	layered cylindrical	90	80	70
	173	215 (3.90)	Area A	midden	irregular	basin	300	220	52
	187	116 (2.10)	Area B	pit	circular	basin	90	75	50
	188	145 (2.63)	Area B	pit	oval	layered basin	100	80	70
	196	134 (2.43)	Area B	pit	circular	layered basin	98	96	50
Liahn I	19	231 (11.30)	north (inside)	pit	irregular	symmetrical	130-230		28-38
	36B	145 (7.09)	middle (inside)	pit	circular	symmetrical			
	58B	178 (8.70)	south (inside)	pit	circular	symmetrical	135		43
	75	480 (23.47)	south (inside)	pit	irregular	symmetrical			
	79	163 (7.97)	south (inside)	pit	circular	symmetrical			
	92	125 (6.11)	south (outside)	pit/earth oven	circular	symmetrical	120		33
	95A	109 (5.33)	south (outside)	pit	irregular	symmetrical	150		46

Note: Only features with ≥100 specimens are listed. Liahn I location refers to the dwelling structure. The value in parenthesis represents the overall percentage of the assemblage within the feature.

Flotation of palaeosols results in the total recovery of archaeological fauna (Shaffer and Baker 1999:1182). Screening, in comparison, limits specimen recovery by size; generally only those remains with a maximum dimension greater or equal to the mesh size will be routinely recovered. In the present study, faunal specimens smaller than 6 mm probably passed through the screen. In order to ensure the most accurate representation of assemblage fragmentation, the large mammal remains recovered through flotation were included whenever possible. These data were available for the Liahn I and Dobbelaar sites, but not for the Montoya or Inland Aggregates West Location 12 sites. In fact, the Liahn I screened and floated components were curated together and could not be studied separately.

Figure 4.5 (see also Appendix E: Table I) illustrates the proportion of large mammal specimens recovered by sieving and flotation at Dobbelaar. While screening accounted for the majority of the recovered assemblage, approximately one-third (i.e. 48/150, 32%) of the specimens were identified in the floatation samples. Seventy-seven percent (i.e., 37/48) of the floated specimens fall within the 0-20 mm category, with all but one under 40 mm in maximum dimension. Considered together, these data suggest that fragments of all sizes, particularly those at the smaller end of the spectrum (i.e., 0-40 mm), will be underrepresented in the Montoya and Inland Aggregates West Location 12 large mammal assemblages. This phenomenon can be observed in Figure 4.6 and Table II in Appendix E, and must be carefully considered when examining the overall extent of fragmentation observed at these sites, the processes influencing the fragmentation, as well as the identified proportions of the different bone types.

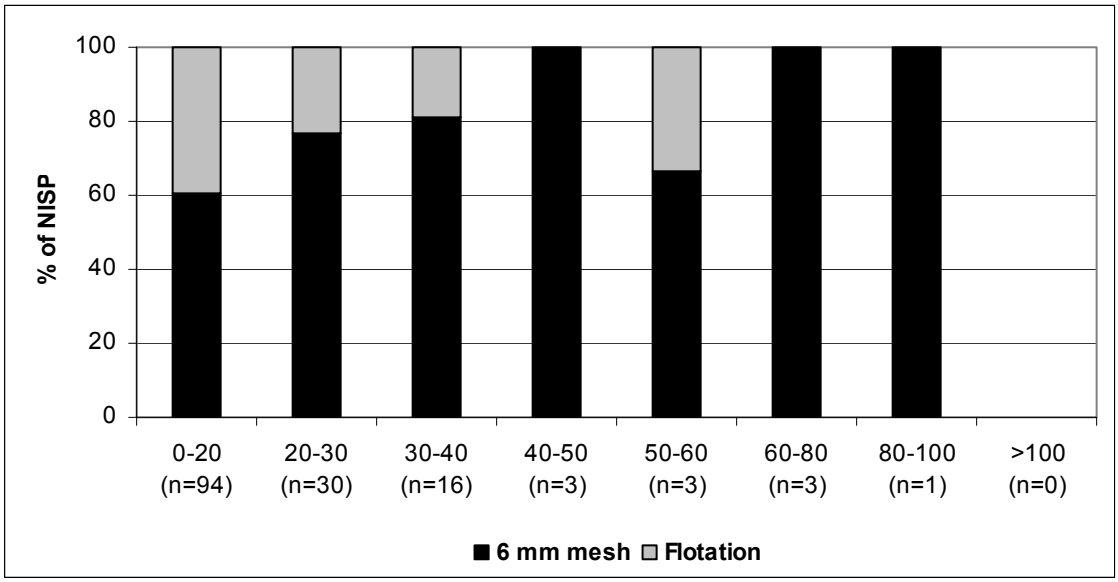

Figure 4.5. The influence of recovery method on size category distribution by NISP for the Dobbelaar large mammal assemblage (n=150).

In addition to size, bone type was recorded using criteria based on Outram (1998, 2001). Specimens were classified as: antler, axial/cranial cancellous bone, tooth, rib, long bone articulations and shaft, cortical long bone shaft, small compact hand or foot bone, indeterminate cancellous bone, indeterminate cancellous and cortical bone, or indeterminate cortical bone. Additionally, the surfaces of each specimen were examined for evidence of cultural modifications, such as cut marks, drill holes, polish, craft working, impact scars, use as a tool, and evidence of burning, as well as post-discard natural alterations including root etching, weathering, carnivore or rodent gnawing, and evidence of carnivore digestion. The degree of burning was scored following Stiner et al. (1995), while weathering stage was recorded using the criteria defined by Behrensmeyer (1978).

Additional characteristics were recorded for 10% of the cortical long bone fragments in the 30-40 mm and 40-50 mm size categories and for all cortical long bone shaft fragments greater or equal to 50 mm in maximum dimension. As evidence of long bone fracture was only recorded for specimens greater or equal to 30 mm, only minimal differences in the total number of observable specimens should exist between the screened (i.e., Montoya and Inland Aggregates West

Location 12) and floated (i.e., Liahn I and Dobbelaar) assemblages. Following Outram (1998:112, 2001:405) the nature of the fracture was recorded based on: fracture angle, defined as the angle of fracture relative to the cortical surface; the fracture outline, which describes the basic shape of the fracture as it travels in the bone wall; and the fracture edge texture, recorded as either rough or smooth. Each of these characteristics was assigned a score between 0 and 2: 0 indicates a fresh break, 1 a fracture with both fresh and unfresh characteristics, and 2 an unfresh fracture (Outram 1998:122). These criteria are combined to derive the Fracture Freshness Index (FFI), whose maximum value is 6, and represents a fracture lacking fresh features.

The index suggests the relative length of time that has passed between an animal's death and when a long bone was broken, as well as the influence of storage and cooking practices (i.e., freezing, baking, boiling) on the fracture angle, outline, and texture (Outram 1998, 2001, 2002). Low FFI scores (i.e., 0, 1) generally represent long bone breakage relatively soon after an animal's death and are characterized by helical or spiral fractures (Outram 1998, 2002). Conversely, high FFI scores (i.e., 5, 6) suggest long bone breakage after the bone has lost much of its organic content through natural and cultural processes. These fractures are characterized by transverse, columnar, or irregular outlines, and generally occur quite some time after the kill (Outram 1998, 2002).

Results and Discussion

The degree of preservation influences archaeofaunal assemblage identifiability and the level of certainty of zooarchaeological interpretations. In general, the more fragmented and friable the assemblage, the more difficult it is to determine bone type, identify skeletal elements, human modification, and the influence of post-discard natural agents. The highly fragmented nature of the Western Basin assemblages examined here posed some interpretive challenges, but did not prevent a deeper understanding of Western Basin cervid processing and discard patterns.

Understanding Western Basin Cervid Assemblage Creation: Insight derived from Fragment Size, Long Bone Fracture Patterns, and Burning

As noted at the outset of this study, Western Basin large mammal assemblages are extremely fragmented. This section uses a variety of characteristics to demonstrate that this fragmentation can best be explained by the purposeful exploitation of within-bone nutrients from the cervid skeleton. While other taphonomic processes, including weathering, trampling, bioturbation, recovery method, and curation also influenced bone friability and fragment size, the data indicate that their role was overshadowed by prehistoric cultural actions.

The degree of assemblage fragmentation was quantified by examining the size distribution of the large mammal remains recovered at each of the four analyzed sites (Figure 4.6; Appendix E: Table II). Figure 4.6 illustrates that the majority (>95%) of the specimens fall within the 0 to 50 mm range. As was noted above, the smaller size classes are probably underrepresented in the Montoya and Inland Aggregates West Location 12 sites, given that the specimens recovered in the flotation samples were not available for analysis. Despite this recovery bias, it appears that the largest proportion (>71% and >37% respectively) of the collected large mammal remains in these locations still falls within the 0-20 mm range. The consistently high degree of fragmentation among the analyzed Western Basin assemblages, regardless of recovery method, geographic location, season of occupation, and temporal period, suggests a strong cultural, as opposed to natural, influence on their formation.

Although the recording of long bone fracture characteristics in this study was limited to a small subset (ranging from 2% at Liahn I to 11% at Dobbelaar) of each assemblage (Tables 4.3 and 4.4), the majority (>87%) of the scored fractures were of the helical/spiral type (Table 4.3), with FFI values between 0 and 1 (Table 4.4). This implies that long bones were consistently broken in a fresh state, and that the Western Basin collection of bone marrow and grease occurred shortly after the kill. Earlier stages of the butchering process, indicated by cut marks, and evidence for marrow extraction in the form of impact scars and bone flakes, were obscured by the subsequent fragmentation of appendicular

and axial elements for grease extraction (see Binford 1978:153-157; Brink 1997:272).

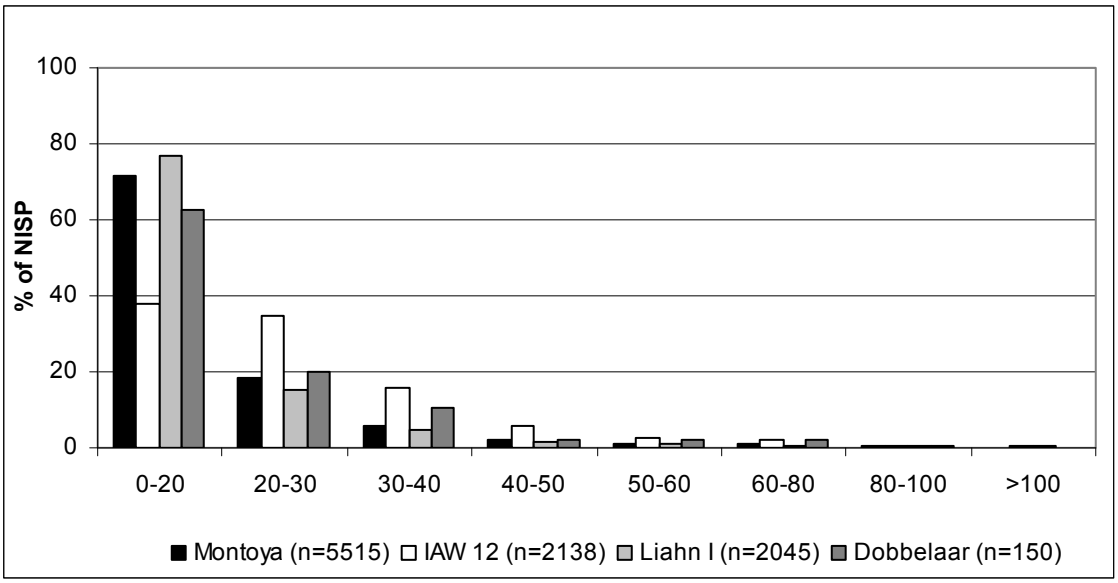

Figure 4.6. Size category distribution by NISP at Western Basin sites.

Table 4.3. Cortical long bone fragment fracture type at Western Basin sites

Fracture Type	Montoya	IAW 12	Liahn I	Dobbelaar
Helical/Spiral	160 (98.16)	64 (100.00)	37 (88.10)	14 (87.50)
Diagonal	2 (1.23)	0	0	0
Sawtoothed and Columnar	1 (0.61)	0	0	0
Longitudinal	0	0	4 (9.52)	1 (6.25)
Longitudinal and Transverse	0	0	1 (2.38)	0
Irregular	0	0	0	1 (6.25)
Total	163	64	42	16

Note: The value in parenthesis represents the percentage represented by the category.

Table 4.4. Cortical long bone fragment Fracture Freshness Index (FFI) for Western Basin sites

Fracture Freshness Index	Montoya	IAW 12	Liahn I	Dobbelaar
0	142 (87.12)	61 (95.31)	32 (76.19)	13 (81.25)
1	4 (2.45)	3 (4.69)	0	0
2	2 (1.23)	0	4 (9.52)	1 (6.25)
3	14 (8.59)	0	2 (4.76)	1 (6.25)
4	0	0	1 (2.38)	0
5	0	0	1 (2.38)	0
6	1 (0.61)	0	2 (4.76)	1 (6.25)
Total	163	64	42	16

Note: The value in parenthesis represents the percentage represented by the category.

The identification of other fracture types and FFI scores greater than or equal to 2 within the Montoya, Liahn I, and Dobbelaar assemblages, suggests that some long bones were fractured in a partially dry or dry state. Given that these specimens are few in number, they likely reflect instances of post-depositional breakage, likely from trampling, bioturbation, freezing and thawing, etc. The edge-rounding and soft, friable texture that characterizes many of the recovered specimens, especially those in the 30-50 mm range, limited the observation of fracture angle, outline, and edge texture. This weathering, in conjunction with root etching, occurred following human discard. While these natural processes and those associated with the excavation and curation of the assemblages likely reduced the overall size of some of the specimens (either through rounding or breakage followed by rounding), the Western Basin exploitation of bone grease is the best explanation for the majority of the observed fragmentation.

Large proportions (between 50% at Liahn I and 95% at Inland Aggregates West Location 12) of the recovered specimens did not display evidence of burning (Figure 4.7; Appendix E: Table III). Those that did, however, were generally scored in the 3 to 6 range (Appendix E: Table III) suggesting that Western Basin bone burning activities were intense when they occurred. Figure 4.7 and Table III in Appendix E also demonstrate the variation in burning intensity by site, with the Montoya and Liahn I assemblages exhibiting the greatest variability. Examination of the degree of burning by fragment size (Appendix E: Table IV) indicates that the smaller categories, particularly those under 50 mm in maximum dimension, are most affected by this activity. Researchers (Cain 2005; Hanson and Cain 2007; Nicholson 1993; Shipman et al. 1984; Stiner et al. 1995) have noted that burning compromises the microscopic structure and strength of bone, leading to increased friability and fragmentation. It is therefore likely that some of the small specimens recorded in these assemblages were produced following the burning of larger fragments.

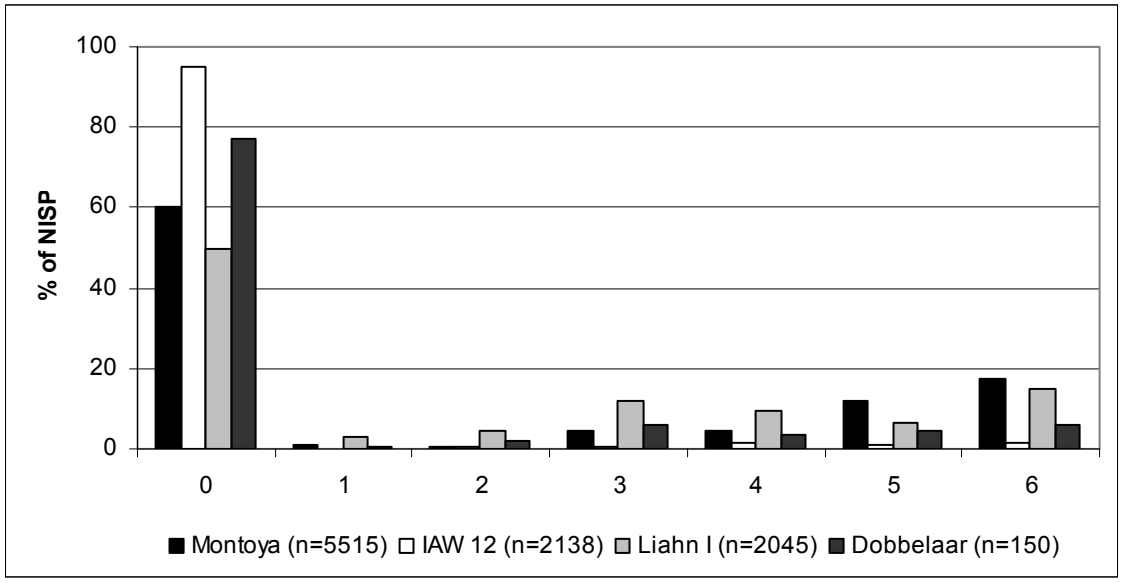

Figure 4.7. Degree of Western Basin assemblage burning (Stiner et al. 1995). 0 = not burned (cream/tan), 6 = fully calcined (completely white).

The ethnographic and archaeological records document the burning of bone as part of: the cooking process (e.g., roasting of meat on the bone), the bone marrow and grease extraction process (e.g., when appendicular elements are heated in the coals or fire to make breakage easier and/or to liquefy the marrow and grease stores), the tool manufacturing process, the waste disposal process, and as a source of fuel (see Bennett 1999; Binford 1978; Cain 2005; Nicholson 1993; Zierhut 1967). The first three instances generally result in localized burning (represented by scores of 1 and 2) of the portions in direct contact with the fire or coals. The latter two activities, however, produce specimens that demonstrate variation in the degree of burning. Several factors influence the observed variability, including the horizontal and vertical location of the specimens within the fire/hearth, the length of time the specimens remain in the fire/hearth, and the temperature of the fire (Bennett 1999; Cain 2005; Hanson and Cain 2007; Nicholson 1993; Shipman et al. 1984; Stiner et al. 1995). Given the abundance of firewood available within the Carolinian forest, it is unlikely that Western Basin groups frequently used mammal bones for fuel. Rather, the burned fragments within these assemblages more likely represent the remains of waste disposal (see Cain 2005; Nicholson 1993:412). The small size of the

fragments and predominance of scores greater than or equal to 3 (Appendix E: Table IV), indicating complete burning, suggests that they were burned following processing (i.e., bone grease extraction) activities.

Considered together, the fragmentation, long bone fracture, and burning data collected from the four Western Basin large mammal assemblages suggests that human actions were primarily responsible for the overall state of their preservation. Long bones were broken for marrow removal shortly after the kill, and subsequent fragmentation of these elements, as well as those of the axial skeleton for bone grease, erased the evidence of this activity from the majority of the specimens.

A recent study (Church and Lyman 2003) on grease extraction from white-tailed deer long bones determined that specimens less than or equal to 50 mm in maximum dimension were optimal for grease removal by boiling. Given the abundance of Western Basin large mammal specimens in the 0-50 mm range, the assertion that Western Basin peoples routinely extracted grease from the cervids they hunted is further supported. It also appears that some of the large mammal specimens were burned following within-bone nutrient removal, but prior to their final disposal, at all four sites. The next section examines the variability in Western Basin cervid processing and discard patterns at Montoya and Liahn I. In so doing, similarities and differences in butchering and disposal activities within and between sites are investigated.

Interpreting Western Basin Patterns of Cervid Processing and Discard: Division by Bone Type

Analysis of the four Western Basin large mammal assemblages suggests that (nearly) complete cervid carcasses were returned to the sites for processing. Both axial and appendicular elements, including the small bones of the hands and feet, were recovered in all contexts (Table 4.5). The high degree of fragmentation that characterizes the Montoya, Inland Aggregates West Location 12, Liahn I, and Dobbelaar assemblages resulted in the placement of large proportions (>35%) of specimens in the indeterminate bone element and type categories (Tables 4.5 and 4.6). Few complete elements, long bone ends, and large (>100 mm) shaft fragments with well-preserved morphological

Table 4.5. Element identification at Western Basin sites

Element	Montoya	IAW 12	Liahn I	Dobbelaar
Antler	31 (0.56)	17 (0.80)	109 (5.33)	1 (0.67)
Cranium	162 (2.94)	24 (1.12)	36 (1.76)	15 (10.00)
Maxilla	3 (0.05)	0	0	0
Mandible	28 (0.51)	1 (0.05)	0	0
Mandible or Maxilla	21 (0.38)	0	0	0
Tooth	195 (3.54)	2 (0.09)	18 (0.88)	0
Vertebra	106 (1.92)	224 (10.48)	6 (0.29)	0
Rib	212 (3.84)	155 (7.25)	36 (1.76)	1 (0.67)
Scapula	1 (0.02)	4 (0.19)	3 (0.15)	0
Humerus	3 (0.05)	14 (0.65)	1 (0.05)	0
Radius	1 (0.02)	7 (0.33)	1 (0.05)	0
Ulna	3 (0.05)	8 (0.37)	0	0
Metacarpal	11 (0.20)	4 (0.19)	0	1 (0.67)
Carpal	9 (0.16)	6 (0.28)	2 (0.10)	0
Innominate	7 (0.13)	9 (0.42)	0	0
Femur	3 (0.05)	20 (0.94)	0	0
Patella	1 (0.02)	3 (0.14)	1 (0.05)	0
Tibia	3 (0.05)	23 (1.08)	6 (0.29)	0
Metatarsal	20 (0.36)	14 (0.65)	1 (0.05)	0
Tarsal	32 (0.58)	12 (0.56)	4 (0.20)	0
Phalanx 1	26 (0.47)	11 (0.51)	3 (0.15)	0
Phalanx 2	24 (0.44)	8 (0.37)	3 (0.15)	1 (0.67)
Phalanx 3	23 (0.42)	4 (0.19)	2 (0.10)	0
Phalanx Unknown	32 (0.58)	0	1 (0.05)	0
Sesamoid	5 (0.09)	0	2 (0.10)	0
Metapodial	57 (1.03)	2 (0.09)	6 (0.29)	1 (0.67)
Long Bone	2511 (45.53)	137 (6.41)	513 (25.09)	29 (19.33)
Indeterminate	1985 (35.99)	1429 (66.84)	1291 (63.13)	101 (67.33)
Total	5515	2138	2045	150

Note: The value in parenthesis represents the overall percentage of the assemblage represented by the element.

Table 4.6. Bone type representation at Western Basin sites

Bone Type	Montoya	IAW 12	Liahn I	Dobbelaar
Antler	31 (0.56)	17 (0.80)	109 (5.33)	1 (0.67)
Axial/Cranial Cancellous Bone	329 (5.97)	490 (22.92)	45 (2.20)	15 (10.00)
Tooth	195 (3.54)	2 (0.09)	18 (0.88)	0
Rib	212 (3.84)	155 (7.25)	36 (1.76)	1 (0.67)
Long Bone Articulations and Shaft	64 (1.16)	85 (3.98)	12 (0.59)	1 (0.67)
Cortical Long Bone Shaft	2548 (46.20)	145 (6.78)	531 (25.97)	30 (20.00)
Small Compact Hand or Foot Bone	154 (2.79)	44 (2.06)	18 (0.88)	1 (0.67)
Indeterminate Cancellous Bone	970 (17.59)	167 (7.81)	317 (15.50)	14 (9.33)
Indeterminate Cancellous and Cortical Bone	888 (16.10)	508 (23.76)	264 (12.91)	36 (24.00)
Indeterminate Cortical Bone	124 (2.25)	525 (24.56)	695 (33.99)	51 (34.00)
Total	5515	2138	2045	150

Note: The value in parenthesis represents the overall percentage of the assemblage represented by the category.

characteristics were recovered, limiting identification. Cranial (including antler and tooth), vertebral, rib, and cortical long bone shaft fragments were most easily recognized.

Tables 4.5 and 4.6 document the assignment of much lower proportions of large mammal specimens to the indeterminate bone element and bone type categories at Montoya compared to the other three sites, and a slightly lower proportion of specimens to the indeterminate bone type categories at Inland Aggregates West Location 12 compared to Liahn I and Dobbelaar. This may partially be explained by the recovery method(s) employed; a greater number of small, unidentifiable specimens were collected from the Liahn I and Dobbelaar flotation samples than from the screened Montoya and Inland Aggregates West Location 12 assemblages. At Montoya, this phenomenon may further be attributed to the abundance (i.e., 46%) of cortical long bone in the assemblage. In most circumstances, this bone type preserves better than cancellous or mixed cancellous and cortical bone.

Fine-grained intra-site analysis of the distribution of bone type and bone element at Montoya and Liahn I indicates that Western Basin cervid processing and in some cases discard activities separated appendicular and axial elements. As will be demonstrated below, similar trends at Inland Aggregates West Location 12 suggest longevity and consistency to these practices.

As was noted above, both the Montoya and Liahn I assemblages are intensively fragmented. Over 75% of the specimens within each of the features are less than or equal to 30 mm in maximum dimension (Appendix E: Table V). If the fauna recovered from the Montoya site flotation samples were available for analysis, this figure would likely be higher.

Figure 4.8 illustrates (see also Appendix E: Tables VI, VII, and VIII) the proportions of axial, appendicular, and indeterminate large mammal specimens identified within each feature. Appendicular specimens dominate the assemblage at Montoya, while indeterminate specimens are most abundant at Liahn I. These differences likely reflect the different recovery methods used at the two sites. The variability in processing and discard activities observed at Montoya and Liahn I

are demonstrated by examining the bone elements identified within each feature as well as the degree of fragmentation and burning by bone type.

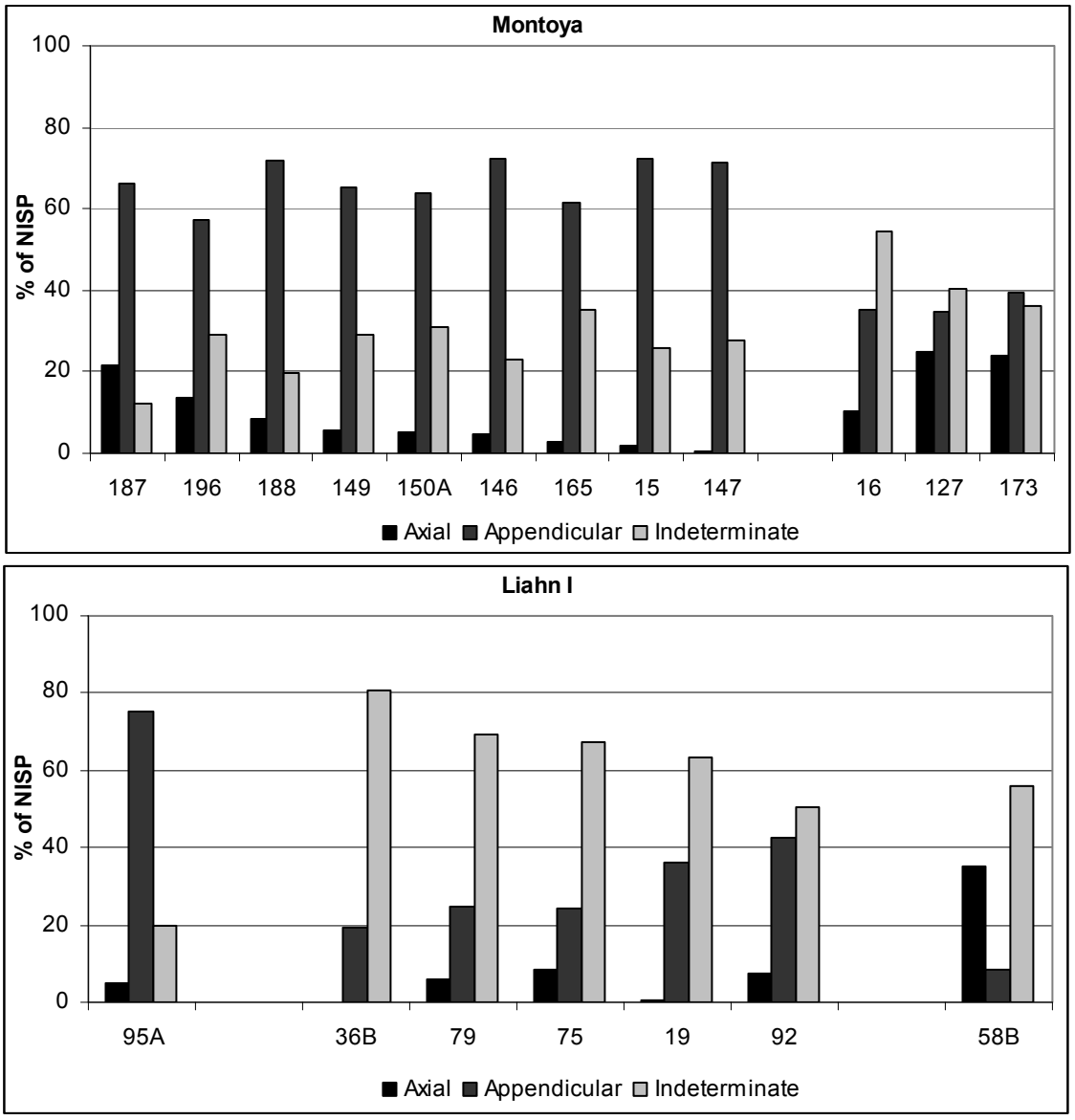

Figure 4.8. Proportion of Montoya and Liahn I bone types by feature. Tooth fragments have been removed from the axial bone category to produce a more accurate representation.

At both the Montoya and Liahn I sites, appendicular bone is best represented by indeterminate long bone fragments (Tables 4.7 and 4.8). The prevalence of cranial and post-cranial axial elements does differ, however, between the two sites, with the former prevailing at Liahn I, while both cranial and post-cranial axial specimens were identified at Montoya. Figure 4.7 and Tables 4.9 and 4.10 (see also Appendix E: Tables III and IX) demonstrate a better representation of burning categories at Liahn I versus Montoya, especially those with scores between 1 and 4. In both assemblages, appendicular and indeterminate specimens were burned more consistently than axial specimens.

In an effort to identify similarities and differences in the cervid processing and discard patterns within the sites, features were grouped based on the proportions of the different bone types (Figure 4.8). Two patterns were observed at Montoya while three were identified at Liahn I. They are discussed in detail here and demonstrate the uniform nature of these activities within the Western Basin community between A.D. 800 and 1600.

One strategy observed at both sites was the extraction of marrow and grease from the long bones of the appendicular skeleton. Features 15, 146, 147, 149, 150A, 165, 187, 196, and 188 at Montoya and Feature 95A at Liahn I provide evidence of these activities. Appendicular specimens, particularly cortical long bone (Tables 4.7 and 4.8; Appendix E: Tables VI, VII, and VIII), dominate (>57%) the large mammal assemblages recovered from these features. Their proportions of axial remains vary from 0.7 to 22% and the proportions of indeterminate specimens vary from 12 to 35%. Such variability in the proportions of appendicular and axial remains likely reflects the localized, and perhaps event-specific nature of Western Basin processing, waste treatment, and disposal activities, and is further supported by the variability in fragment size and degree of burning observed between the features (Tables 4.9 and 4.10; Appendix E: Tables VII, VIII, and IX). Overall, axial elements are not extensively burned and are less fragmented than the recovered appendicular and indeterminate specimens; however, there are some exceptions. For instance, burning of the specimens recovered from Features 15, 146, 147, and 149 at Montoya was more

intense, as suggested by the large proportions of each assigned to the higher (≥3) burning categories (Table 4.9; Appendix E: Table IX). Further, the appendicular specimens in Features 187, 188, and 196 are more complete than the others mentioned here, with some specimens in the 50 to 80 mm size range.

Table 4.7. Montoya elements by feature

Element	15	16	127	146	147	149
Antler	0	0	0	0	0	0
Cranium	2 (1.72)	35 (2.17)	67 (7.84)	7 (4.73)	0	6 (5.45)
Maxilla	0	0	2 (0.23)	0	0	0
Mandible	0	4 (0.25)	7 (0.82)	0	1 (0.34)	0
Mandible or Maxilla	0	9 (0.56)	0	0	0	0
Tooth	0	43 (2.66)	45 (5.26)	0	0	4 (3.64)
Vertebra	0	52 (3.22)	13 (1.52)	0	1 (0.34)	0
Rib	0	58 (3.59)	107 (12.51)	0	0	0
Humerus	0	1 (0.06)	1 (0.12)	0	0	0
Ulna	0	0	1 (0.12)	0	0	0
Metacarpal	0	0	4 (0.47)	0	0	0
Carpal	2 (1.72)	2 (0.12)	1 (0.12)	0	1 (0.34)	0
Innominate	0	2 (0.12)	5 (0.58)	0	0	0
Femur	0	1 (0.06)	1 (0.12)	0	0	0
Tibia	0	2 (0.12)	1 (0.12)	0	0	0
Metatarsal	0	2 (0.12)	11 (1.29)	0	0	0
Tarsal	2 (1.72)	3 (0.19)	6 (0.70)	1 (0.68)	2 (0.68)	0
Phalanx 1	2 (1.72)	1 (0.06)	7 (0.82)	4 (2.70)	0	0
Phalanx 2	0	0	11 (1.29)	0	1 (0.34)	0
Phalanx 3	2 (1.72)	0	9 (1.05)	1 (0.68)	1 (0.34)	1 (0.91)
Phalanx Unknown	3 (2.59)	5 (0.31)	12 (1.40)	0	0	1 (0.91)
Sesamoid	0	0	3 (0.35)	0	0	1 (0.91)
Metapodial	2 (1.72)	15 (0.93)	10 (1.17)	1 (0.68)	1 (0.34)	2 (1.82)
Long Bone	71 (61.21)	519 (32.14)	203 (23.74)	100 (67.57)	204 (69.39)	64 (58.18)
Indeterminate	30 (25.86)	861 (53.31)	328 (38.36)	34 (22.97)	82 (27.89)	31 (28.18)
Total	116	1615	855	148	294	110

Note: The value in parenthesis represents the percentage represented by the category.

Table 4.7. Continued

Element	150A	165	173	187	188	196
Antler	0	0	0	14 (12.07)	5 (3.45)	0
Cranium	4 (1.16)	0	10 (4.65)	5 (4.31)	6 (4.14)	2 (1.49)
Maxilla	0	0	0	0	1 (0.69)	0
Mandible	0	0	0	0	0	1 (0.75)
Mandible or Maxilla	7 (2.02)	0	1 (0.47)	0	0	0
Tooth	52 (15.03)	14 (5.05)	3 (1.40)	0	2 (1.38)	0
Vertebra	0	0	19 (8.84)	2 (1.72)	0	7 (5.22)
Rib	4 (1.16)	8 (2.89)	21 (9.77)	4 (3.45)	0	8 (5.97)
Humerus	0	0	1 (0.47)	0	0	0
Radius	0	1 (0.36)	0	0	0	0
Ulna	0	0	0	0	1 (0.69)	0
Metacarpal	0	1 (0.36)	3 (1.40)	0	2 (1.38)	0
Carpal	0	2 (0.72)	0	0	0	0
Femur	0	0	0	1 (0.86)	0	0
Metatarsal	1 (0.29)	0	3 (1.40)	3 (2.59)	0	0
Tarsal	0	6 (2.17)	2 (0.93)	0	1 (0.69)	0
Phalanx 1	1 (0.29)	3 (1.08)	0	2 (1.72)	1 (0.69)	0
Phalanx 2	2 (0.58)	3 (1.08)	0	2 (1.72)	0	1 (0.75)
Phalanx 3	1 (0.29)	3 (1.08)	0	0	2 (1.38)	1 (0.75)
Phalanx Unknown	0	3 (1.08)	1 (0.47)	0	1 (0.69)	0
Metapodial	0	6 (2.17)	4 (1.86)	1 (0.86)	2 (1.38)	0
Long Bone	183 (52.89)	134 (48.38)	70 (32.56)	68 (58.62)	93 (64.14)	75 (55.97)
Indeterminate	91 (26.30)	93 (33.57)	77 (35.81)	14 (12.07)	28 (19.31)	39 (29.10)
Total	346	277	215	116	145	134

Note: The value in parenthesis represents the percentage represented by the category.

Table 4.8. Liahn I elements by feature

Element	19	36B	58B	75	79	92	95A
Antler	0	0	60 (33.71)	0	2 (1.23)	1 (0.80)	5 (4.59)
Cranium	0	0	1 (0.56)	21 (4.38)	1 (0.61)	8 (6.40)	0
Tooth	9 (3.90)	0	0	4 (0.83)	0	0	3 (2.75)
Vertebra	1 (0.43)	0	1 (0.56)	1 (0.21)	1 (0.61)	0	0
Rib	0	0	0	18 (3.75)	6 (3.68)	0	0
Scapula	0	0	1 (0.56)	1 (0.21)	0	0	0
Humerus	1 (0.43)	0	0	0	0	0	0
Radius	0	0	0	1 (0.21)	0	0	0
Carpal	0	0	0	1 (0.21)	0	0	0
Patella	1 (0.43)	0	0	0	0	0	0
Tibia	1 (0.43)	0	0	1 (0.21)	1 (0.61)	1 (0.80)	1 (0.92)
Metatarsal	0	0	0	1 (0.21)	0	0	0
Tarsal	1 (0.43)	0	0	1 (0.21)	0	0	0
Phalanx 1	0	0	0	1 (0.21)	0	0	0
Phalanx 2	0	0	1 (0.56)	0	1 (0.61)	0	0
Phalanx 3	0	0	0	0	2 (1.23)	0	0
Phalanx Unknown	0	0	0	1 (0.21)	0	0	0
Sesamoid	0	1 (0.69)	1 (0.56)	0	0	0	0
Metapodial	0	1 (0.69)	1 (0.56)	1 (0.21)	0	1 (0.80)	0
Long Bone	76 (32.90)	26 (17.93)	12 (6.74)	107 (22.29)	36 (22.09)	51 (40.80)	79 (72.48)
Indeterminate	141 (61.04)	117 (80.69)	100 (56.18)	320 (66.67)	113 (69.33)	63 (50.40)	21 (19.27)
Total	231	145	178	480	163	125	109

Note: The value in parenthesis represents the percentage represented by the category.

Table 4.9. Montoya bone type by degree of burning

Axial	15	16	127	146	147	149
0	1 (0.86)	159 (10.11)	201 (24.81)	0	1 (0.34)	2 (1.89)
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	1 (0.86)	0	0	1 (0.68)	0	0
4	0	0	0	1 (0.68)	0	0
5	0	1 (0.06)	0	5 (3.38)	1 (0.34)	4 (3.77)
6	0	0	0	0	0	0
Total	2 (1.72)	160 (10.18)	201 (24.81)	7 (4.73)	2 (0.68)	6 (5.66)
Appendicular	**15**	**16**	**127**	**146**	**147**	**149**
0	1 (0.86)	483 (30.73)	271 (33.46)	13 (8.78)	21 (7.14)	12 (11.32)
1	0	0	8 (0.99)	3 (2.03)	3 (1.02)	0
2	2 (1.72)	0	1 (0.12)	0	0	0
3	4 (3.45)	1 (0.06)	0	3 (2.03)	16 (5.44)	2 (1.89)
4	21 (18.10)	3 (0.19)	0	5 (3.38)	28 (9.52)	5 (4.72)
5	40 (34.48)	20 (1.27)	1 (0.12)	35 (23.65)	57 (19.39)	24 (22.64)
6	16 (13.79)	46 (2.93)	0	48 (32.43)	85 (28.91)	26 (24.53)
Total	84 (72.41)	553 (35.18)	281 (34.69)	107 (72.30)	210 (71.43)	69 (65.09)
Indeterminate	**15**	**16**	**127**	**146**	**147**	**149**
0	0	764 (48.60)	328 (40.49)	1 (0.68)	0	2 (1.89)
1	0	1 (0.06)	0	0	1 (0.34)	0
2	0	0	0	1 (0.68)	1 (0.34)	0
3	0	4 (0.25)	0	2 (1.35)	4 (1.36)	0
4	7 (6.03)	15 (0.95)	0	5 (3.38)	14 (4.76)	5 (4.72)
5	19 (16.38)	21 (1.34)	0	6 (4.05)	62 (21.09)	10 (9.43)
6	4 (3.45)	54 (3.44)	0	19 (12.84)	0	14 (13.21)
Total	30 (25.86)	859 (54.64)	328 (40.49)	34 (22.97)	82 (27.89)	31 (29.25)
Feature Total	116	1572	810	148	294	106

Note: The value in parenthesis represents the percentage of cervid specimens within the feature. Tooth fragments have been removed from the axial bone category to produce a more accurate representation.

Table 4.9. Continued

Axial	150A	165	173	187	188	196
0	7 (2.38)	3 (1.14)	48 (22.64)	25 (21.55)	12 (8.39)	13 (9.70)
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	1 (0.47)	0	0	2 (1.49)
4	0	2 (0.76)	1 (0.47)	0	0	0
5	0	1 (0.38)	1 (0.47)	0	0	3 (2.24)
6	8 (2.72)	2 (0.76)	0	0	0	0
Total	15 (5.10)	8 (3.04)	51 (24.06)	25 (21.55)	12 (8.39)	18 (13.43)
Appendicular	**150A**	**165**	**173**	**187**	**188**	**196**
0	63 (21.43)	40 (15.21)	71 (33.49)	37 (31.90)	54 (37.76)	9 (6.72)
1	0	5 (1.90)	0	0	8 (5.59)	3 (2.24)
2	0	2 (0.76)	0	0	0	2 (1.49)
3	7 (2.38)	21 (7.98)	3 (1.42)	0	0	4 (2.99)
4	8 (2.72)	31 (11.79)	2 (0.94)	6 (5.17)	2 (1.40)	7 (5.22)
5	25 (8.50)	42 (15.97)	4 (1.89)	9 (7.76)	13 (9.09)	20 (14.93)
6	85 (28.91)	21 (7.98)	4 (1.89)	25 (21.55)	26 (18.18)	32 (23.88)
Total	188 (63.95)	162 (61.60)	84 (39.62)	77 (66.38)	103 (72.03)	77 (57.46)
Indeterminate	**150A**	**165**	**173**	**187**	**188**	**196**
0	6 (2.04)	14 (5.32)	75 (35.38)	8 (6.90)	20 (13.99)	22 (16.42)
1	0	6 (2.28)	0	0	3 (2.10)	0
2	0	4 (1.52)	0	0	0	0
3	1 (0.34)	32 (12.17)	2 (0.94)	0	0	4 (2.99)
4	1 (0.34)	12 (4.56)	0	3 (2.59)	1 (0.70)	5 (3.73)
5	22 (7.48)	14 (5.32)	0	0	0	7 (5.22)
6	61 (20.75)	11 (4.18)	0	3 (2.59)	4 (2.80)	1 (0.75)
Total	91 (30.95)	93 (35.36)	77 (36.32)	14 (12.07)	28 (19.58)	39 (29.10)
Feature Total	294	263	212	116	143	134

Note: The value in parenthesis represents the percentage of cervid specimens within the feature. Tooth fragments have been removed from the axial bone category to produce a more accurate representation.

Table 4.10. Liahn I bone type by degree of burning

Axial	19	36B	58B	75	79	92	95A
0	1 (0.45)	0	8 (4.49)	23 (4.83)	1 (0.61)	9 (7.20)	5 (4.72)
1	0	0	0	2 (0.42)	0	0	0
2	0	0	12 (6.74)	2 (0.42)	2 (1.23)	0	0
3	0	0	2 (1.12)	7 (1.47)	5 (3.07)	0	0
4	0	0	14 (7.87)	7 (1.47)	2 (1.23)	0	0
5	0	0	12 (6.74)	0	0	0	0
6	0	0	15 (8.43)	0	0	0	0
Total	1 (0.45)	0	63 (35.39)	41 (8.61)	10 (6.13)	9 (7.20)	5 (4.72)
Appendicular	**19**	**36B**	**58B**	**75**	**79**	**92**	**95A**
0	42 (18.92)	8 (5.52)	3 (1.69)	35 (7.35)	20 (12.27)	21 (16.80)	37 (34.91)
1	0	0	0	7 (1.47)	4 (2.45)	3 (2.40)	0
2	3 (1.35)	1 (0.69)	0	4 (0.84)	1 (0.61)	1 (0.80)	13 (12.26)
3	16 (7.21)	2 (1.38)	2 (1.12)	30 (6.30)	5 (3.07)	2 (1.60)	2 (1.89)
4	3 (1.35)	4 (2.76)	4 (2.25)	12 (2.52)	3 (1.84)	6 (4.80)	10 (9.43)
5	2 (0.90)	5 (3.45)	1 (0.56)	9 (1.89)	3 (1.84)	7 (5.60)	7 (6.60)
6	14 (6.31)	8 (5.52)	5 (2.81)	18 (3.78)	4 (2.45)	13 (10.40)	11 (10.38)
Total	80 (36.04)	28 (19.31)	15 (8.43)	115 (24.16)	40 (24.54)	53 (42.40)	80 (75.47)
Indeterminate	**19**	**36B**	**58B**	**75**	**79**	**92**	**95A**
0	130 (58.56)	15 (10.34)	54 (30.34)	177 (37.18)	11 (6.75)	33 (26.40)	20 (18.87)
1	0	0	5 (2.81)	18 (3.78)	0	3 (2.40)	0
2	0	0	5 (2.81)	10 (2.10)	0	0	0
3	4 (1.80)	1 (0.69)	9 (5.06)	61 (12.82)	53 (32.52)	1 (0.80)	1 (0.94)
4	4 (1.80)	2 (1.38)	17 (9.55)	31 (6.51)	32 (19.63)	3 (2.40)	0
5	0	1 (0.69)	3 (1.69)	15 (3.15)	12 (7.36)	12 (.60)	0
6	3 (1.35)	98 (67.59)	7 (3.93)	8 (1.68)	5 (3.07)	11 (8.80)	0
Total	141 (63.51)	117 (80.69)	100 (56.18)	320 (67.23)	113 (69.33)	63 (50.40)	21 (19.81)
Feature Total	222	145	178	476	163	125	106

Note: The value in parenthesis represents the percentage of cervid specimens within the feature. Tooth fragments have been removed from the axial bone category to produce a more accurate representation.

The second cervid processing and disposal pattern observed at Montoya, exemplified by Features 16, 127, and 173, suggests the extraction of bone grease from axial elements in addition to the processing of long bones for bone marrow and grease. This is evidenced by a moderate to high proportion (>36%) of indeterminate bone, a moderate proportion (between 34 and 40%) of appendicular bone, again, mostly represented by cortical long bone fragments (Appendix E: Table VI), and a small to moderate (between 10 and 25%) proportion of axial bone within these three features (Table 4.7; Appendix E: Table VI). In fact, cranial, vertebral, and rib fragments were more prevalent in Features 16, 127, and 173 than in most of the other features examined at the site (Table 4.7; Appendix E: Table VI).

Many specimens were from the larger size categories (Appendix E: Table V), indicating that the large mammal assemblages recovered from these features were not as fragmented as those discussed above. The larger fragment sizes permitted a higher percentage of the remains from these features to be identified to element. In addition, more than 90% of the specimens within Features 16, 127, and 173 were assigned a burning score of 0 (Appendix E: Table IX), indicating that they were not extensively burned prior to final disposal. Consistent with the pattern noted for the first group of features at Montoya, appendicular and indeterminate specimens were burned more frequently than axial ones (Table 4.9).

At Liahn I, the large proportion (>50%) of indeterminate bone in all of the examined features with the exception of 95A (Table 4.8; Appendix E: Table VI) is strongly associated with the inclusion of the floated feature fill within the large mammal assemblage. Including the flotation sample provides a more accurate representation of the size distribution, but means that a large proportion of the fragments fall within the 0-20 mm category, most of which were too small to allow bone type and element to be identified (Appendix E: Table VIII).

The variation in bone composition, fragment size, and degree of burning that characterizes the large mammal specimens recovered from Liahn I Features 19, 36B, 75, 79, and 92 complicates the interpretation of Western Basin processing and disposal activities at the site. The distribution of bone types within these five features, however, is most similar to that observed in Features 16, 127, and 173 at Montoya (Figure 4.7). They are composed of a high proportion (>50%) of indeterminate bone, a moderate proportion (>19%) of appendicular, bone (predominantly cortical long bone), and a small proportion (between 0 and 9%) of axial bone (Table 4.8; Appendix E: Table VI). Cranial, vertebral, and rib specimens are best represented in Features 75, 79, and 92, while they are nearly or completely absent in Features 19 and 36B (Table 4.8). Further, cortical long bone fragments account for much greater proportions (>30%) of the Feature 19 and 92 assemblages in comparison to the other three (Appendix E: Table VI).

All of the recovered specimens are highly fragmented, with >70% assigned to the 0-20 mm category (Table 4.8; Appendix E: Tables V and VIII). It appears that, within these features, appendicular fragments were not as extensively fragmented as the axial and indeterminate categories (Appendix E: Table VIII). Table 4.10 demonstrates extensive variability between features in the degree of burning. Similar to the second group of features at Montoya, the majority (>50%) of the specimens recovered from Features 19, 75, and 92 were not burned (Appendix E: Table IX). In contrast, most (>50%) of the large mammal specimens in Features 36B and 79 are intensively burned with scores between 3 and 6 (Appendix E: Table IX). As at Montoya, within all features, the appendicular and indeterminate bone fragments were burned more frequently and intensively than the axial ones (Table 4.10).

The large mammal assemblages recovered from these five Liahn I features clearly do not fit either of the bone processing and discard patterns described above. While their compositions and characteristics most closely resemble those in Features 16, 127, and 173 at Montoya, they display a higher degree of fragmentation and more frequent and intensive evidence of burning. It is suggested that the large mammal assemblages recovered from Liahn I Features 19, 36B, 75, 79, and 92 reflect the disposal of waste from multiple processing episodes. Given that the site was occupied many times during the late prehistoric period and the fact that most of the examined pits cut into previously excavated ones (Figure 4.3), it is very likely that the bone waste from distinct processing events, such as those represented by Feature 95A, or Features 16, 127, and 173 at Montoya, was commingled in these features.

The composition of Feature 58B is the last to be considered, and is unique to Liahn I. Within this feature, axial remains, predominantly antler (Table 4.8; Appendix E: Table VI), far outnumber appendicular ones. The recovered specimens are highly fragmented (>70% in the 0-20 mm category) (Appendix E: Tables V and VIII), and more than half are also intensively burned (Table 4.10; Appendix E: Table IX) with scores greater than or equal to 3. While antler was also identified in Features 79, 92, and 95A (Table 4.8; Appendix E: Table VI), its

abundance in Feature 58B is unusual, suggesting yet another pattern of Western Basin processing and disposal. A quick examination of the smaller features at Liahn I noted a similar assemblage composition in Feature 21 (42% antler, 1% cranial, 1% cortical long bone, 56% indeterminate bone, n=81). The treatment and disposal of antler at Liahn I clearly differed from that of other skeletal elements, and may represent the waste produced from the manufacturing of tools or items of personal adornment.

The intra-site analyses of the Montoya and Liahn I large mammal assemblages suggest that Western Basin groups segregated their cervid processing, and in many cases, disposal practices by bone type: appendicular versus axial. Such a separation of processing activities is logical given the different types of marrow and grease stored within these skeletal portions. Overall, appendicular elements were more intensively fragmented and burned compared to axial ones. Given the porous nature of the cancellous bone comprising the majority of the axial skeleton, the same degree of fragmentation required for the efficient removal of grease from cortical long bone was not likely necessary. It also appears that following grease removal, cortical bone waste was often burned prior to final discard, while axial bone waste was not.

At both Montoya and Liahn I, some of the feature compositions imply that appendicular and axial elements were also disposed of separately. Separate disposal of appendicular bone waste is best illustrated in Features 15, 146, 147, 149,150A, 165, 187, 188, and 196 at Montoya and Feature 95A at Liahn I, while Features 16, 127, and 173 at Montoya suggest the discrete disposal of axial bone. While the remaining Liahn I features (i.e., 19, 36B, 75, 79, and 92) include both appendicular and axial refuse, differences in the extent of fragmentation and degree of burning by bone type suggest that the two categories of elements were consistently processed distinctly from one another even when they were disposed of together.

The observed segregation of Western Basin bone processing and discard activities by bone type is also supported by evidence recovered at the Inland Aggregates West Location 12 site. This assemblage is largely composed of axial

specimens (31%; Table 4.5), is not uniformly fragmented, given the proportion of specimens in the large size categories (5% ≥50 mm; Appendix E: Table II), and demonstrates very little evidence of burning (5%; Appendix E: Table III). These characteristics are similar to those noted above for Features 16, 127, and 173 at Montoya.

Preference versus Need: Explaining Western Basin Marrow and Grease Extraction Practices

Most within-bone nutrient studies (e.g., Binford 1978; Blumenschine and Madrigal 1993; Logan 1998; Munro and Bar-Oz 2005; Outram 1998, 2001, 2002, 2004a, b; Speth 1990; Speth and Spielmann 1983; Yellen 1991) use the evolutionary and biological arguments of the human body's need for fat and the consequences of eating too much lean meat to account for the extraction of within-bone nutrients by prehistoric hunter-gatherers. While it is true that most foraging groups experience seasonal or decadal periods of nutritional stress, causing them to exploit all available food sources, including bone marrow and grease, the zooarchaeological analyses presented here suggest that this explanation does not apply in the case of the highly fragmented faunal assemblages produced by Late Woodland Western Basin peoples of southwestern Ontario.

The cold season, particularly the transition from the late winter to the early spring (i.e., February to March), was likely the leanest period in the Western Basin annual round (Chapter 2). From November to March, cached plant and animal resources accounted for a large portion of the diet, and were supplemented by freshly procured mammals, birds, and fish. The ethnographic and historic records (see Ferris 1989, 2006, 2009) from this region suggest that by late February, food stores would have been depleted, local animal populations would be depressed (Speth and Spielmann 1983:3) requiring further travel for successful procurement, cervids would be lean [the males from the effects of the fall rut and the females from pregnancy and the nursing of fawns (Speth and Spielmann 1983:3)], and fresh food resources, in the form of migratory birds, early spawning fish, and new plants, would not yet be available. Thus if food scarcity was driving within-bone nutrient extraction, we would expect to see the

most intensive processing for marrow and grease on winter sites. We would also expect limited evidence for marrow and grease extraction on summer sites, where food resources were more abundant.

This study demonstrates, however, that regardless of season, length, or cultural phase of site occupation, Western Basin peoples consistently extracted bone marrow and grease from the cervids they hunted. The observed carcass-processing patterns cannot be explained by subsistence-related stress. Given the natural and seasonal abundance of plants and animals within the region, it is highly unlikely that members of this community continually faced starvation during the 800 years of interest. While the intensity of within-bone nutrient extraction probably varied throughout the course of the year and over the long term due to fluctuations in the availability of local plant and animal resources, within-bone fats were clearly central to the preparation of meals and the taste of individual dishes within Western Basin cuisine.

The analysis of the Montoya, Inland Aggregates West Location 12, Liahn I, and Dobbelaar large mammal assemblages demonstrated a structured approach to the processing of cervid skeletons, and in many instances, to the disposal of the resulting waste. The white marrow and grease of the appendicular short and long bones was collected separately from the red marrow and yellow grease of the axial elements. While it appears that Western Basin peoples exploited bone marrow and grease from nearly all cervid appendicular (with the exception of the carpals and tarsals) and axial elements, this pattern likely reflects cultural preference rather than seasonal starvation. The long bone fracture characteristics from all four sites indicate that cervid skeletons were processed shortly after death, not after an extended period of time during which the bones lost much of their organic content. The data indicate that the exploitation of appendicular and axial fat resources occurred during both the cold and warm seasons, likely alongside other daily tasks, and was an integral part of Western Basin subsistence from A.D. 800 to 1600.

Summary and Conclusion

Cervid specimens abound in all southwestern Ontario Western Basin faunal assemblages. While it appears that the hunting of these large mammals was most concentrated during the fall and winter, the consistent recovery of their remains from warm season sites indicates that they contributed to the subsistence economy year-round. Despite the observed diversification in Western Basin faunal procurement activities associated with the intensification of domestic crop production some time between A.D. 800 and 1200 (Chapter 3), cervids continued to be extensively exploited.

The data presented here have demonstrated that the fragmented nature of Western Basin cervid assemblages resulted from the purposeful exploitation of bone marrow and grease from both the appendicular and axial skeletal portions. The within-bone nutrients of these elements were collected separately, and it appears that the porous nature of the cranium, vertebrae, and ribs did not require them to be as intensively fragmented as the appendicular bones to facilitate grease extraction. Appendicular specimens were also burned more frequently and displayed higher burn scores compared to axial ones.

Between A.D. 800 and 1600, members of the southwestern Ontario Western Basin community consistently extracted the within-bone marrow and grease from the cervids they procured. These activities were identified at both cold and warm season settlements and are associated with a preference for cervid grease rather than with periods of dietary stress. Cervid bone marrow and grease were important components of the Western Basin daily diet.

These findings raise questions for future research. Comparisons with additional Western Basin faunal assemblages will help determine whether the intensity of within-bone nutrient extraction changed over time as more effort was invested in maize agriculture. Fruitful comparisons could also be made with neighbouring Late Woodland groups, based on both faunal assemblages and ceramics. For example, were the larger, higher-necked Western Basin ceramic vessels more efficient for the removal and storage of bone grease than the shallow, short vessels used by Iroquoian groups? Such studies will provide

further insight into food preparation practices and taste preferences leading to a better understanding of community interactions, and culture-specific views of the regional environment.

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CHAPTER V

SUMMARY OF CONCLUSIONS, CONTRIBUTIONS, AND DIRECTIONS FOR FUTURE RESEARCH

This research programme has demonstrated how zooarchaeological data, which reflect the location and scheduling of hunting and fishing activities, contribute to the reconstruction of southwestern Ontario Late Woodland community mobility and land use. As was noted at the outset, emphasis was placed on using Western Basin faunal assemblages in an attempt to verify or refute the subsistence and settlement model proposed by Murphy and Ferris (1990). Analysis of both Western Basin and Iroquoian archaeofaunal datasets illustrated how members of these traditions distinctly viewed and used their surrounding environment. Further examination suggested how community-specific human-environment interactions changed in response to increased domestic crop production between A.D. 800 and 1600. Finally, the analysis of cervid data recovered from four Western Basin sites demonstrated a strong and persistent tradition of grease extraction among Western Basin communities. The details of these findings are highlighted in the following sections.

Western Basin Seasonally Mobile Hunters and Fishers

Faunal data from 10 sites dating between A.D. 800 and 1400 were used to reconstruct the annual scheduling and location of Western Basin faunal procurement activities. This created an important baseline, which will facilitate future comparisons with additional Western Basin assemblages and the settlement and subsistence strategies of their Iroquoian contemporaries. The reconstruction suggests that: (1) from the spring until the fall, fishing was of utmost importance and occurred near the rivers and lakes within the study area; (2) fish were most intensively exploited during spawning when large numbers could quickly and easily be procured over a short period of time; (3) other aquatic animals, including rodents, waterfowl, reptiles, amphibians, mussels, and snails

were also targeted during the warm season; (4) while mammals were hunted throughout the year, this activity was most intense from the late fall to the early spring; (5) cervids, predominantly white-tailed deer, were preferentially exploited, however terrestrial rodents, raccoon, mustelids, and black bear were also sought, as were terrestrial birds (i.e., wild turkey and grouse); and (6) some groups also fished during the cold season to procure lake whitefish, cisco/lake herring, and lake trout in the fall and burbot in the winter. These data imply greater variation in hunting and fishing activities, settlement location, and length of site occupation throughout the course of the year than was previously recognized (Murphy and Ferris 1990).

Deciphering Late Woodland Community Subsistence and Settlement Strategies, A.D. 800-1600

A comparison of southwestern Ontario Western Basin and Iroquoian faunal data for the period between A.D. 800 and 1600 documented tradition-specific hunting and fishing practices. Western Basin peoples preferentially exploited aquatic resources, especially fish, during the spring and summer, and terrestrial mammals and birds, as well as fall and winter spawning fish during the cold season. As suggested by Kenyon (1988:20), settlements were located in areas where a number of microenvironments could easily be accessed, resulting in the procurement of resources from a much larger catchment than that noted for Iroquoians.

Fishing was an important year-round activity for Western Basin peoples, with all of the major families exploited. This differs from their predominantly terrestrial-oriented southwestern Ontario Iroquoian neighbours, who were merely opportunistic fishers. Members of this Iroquoian community generally settled near interior river tributaries in upland areas where they emphasized the procurement of locally available cervids, terrestrial rodents and birds, beaver, black bear, and fish, particularly sunfish, catfish, pike, and bowfin. While groups frequently left the settlement to hunt and fish during the course of the year, members of this tradition were much less mobile than their Western Basin neighbours.

Despite these differences in mobility, prey selection, and settlement locations, both cultural groups decreased the time devoted to deer hunting and increased their exploitation of small to medium mammals, fish, birds, reptiles, amphibians, and invertebrates during the 800 years of interest. This shift likely occurred some time during the second millennium A.D. and reflects the hunting, fishing, and collecting responses of these communities that are associated with agricultural intensification. Scheduling conflicts arose forcing Western Basin and Iroquoian groups to choose between crop planting versus fishing in the spring, and crop harvesting versus cervid and turkey hunting, and nut collecting in the fall. The zooarchaeological data strongly suggest that both Western Basin and Iroquoian peoples emphasized maize agriculture over hunting and fishing, and given the reduced time available for the latter two activities in the spring and fall, they shifted their emphasis to the animal resources immediately surrounding their settlements during these seasons.

A Western Basin Case Study of Cervid Assemblage Formation: Implications for Southern Ontario Taphonomic Studies

The high degree of fragmentation that characterizes most southern Ontario zooarchaeological assemblages, particularly the large mammal remains, begs the question of their taphonomic history. Using Outram's (1998, 2001) methodology, the analysis of four Western Basin large mammal datasets demonstrated purposeful exploitation of bone marrow and grease from all portions of the cervid skeleton between A.D. 800 and 1600. Following the transport of nearly complete carcasses to the site and the removal of the soft tissues, skeletal elements were processed and often disposed of in two groups, appendicular and axial, suggesting that Western Basin peoples extracted the within-bone nutrients from these skeletal portions separately.

Consistent evidence of fresh long bone fractures within these assemblages coupled with the high proportions (i.e., >95%) of specimens in the 0 to 50 mm size range suggests human processing activities as the primary cause of this extensive fragmentation. Given their greater size, density, and robusticity, which favour their preservation over that of smaller mammals, fish, and birds,

cervid remains are especially suited to the analysis of bone fragment size, type, and fracture characteristics. This taphonomic study provides an important baseline for the comparison of cervid assemblages recovered from earlier contexts and contemporary Iroquoian ones to assess the temporal depth and cultural-specificity of these processing and discard activities in southern Ontario.

Discussion of Major Contributions

Ontario, Great Lakes, and Northeastern Archaeology

This study has improved our understanding of southwestern Ontario's Western Basin community, updating and building upon the summary presented over twenty years ago by Murphy and Ferris (1990). The zooarchaeological data help us better reconstruct Western Basin use and view of the southwestern Ontario environment and resources between A.D. 800 and 1600. Within the southwestern Ontario Western Basin community, the seasonal scheduling of faunal procurement and agricultural activities was more flexible than that of their contemporary Iroquoian neighbours. It is suggested here that this flexibility is linked to the greater annual mobility of members of the Western Basin community, demonstrating, like Chilton (1999) and Smith (2001, 2005), that sedentism is not a necessary precondition for the successful production of domestic crops.

The comparison of Western Basin subsistence and settlement practices to those of Iroquoian groups in southwestern Ontario indicated, that although these peoples occupied the same region and had access to the same resources, they organized themselves and their activities within it very differently. It appears that throughout the Late Woodland period, environmental interactions were strongly influenced by the distinct historical and cultural trajectories of these two traditions. Similar regional analyses need to be conducted using Western Basin assemblages from Michigan and Ohio, and Iroquoian assemblages from southcentral Ontario, New York State, and Pennsylvania, to verify the geographic extent and temporal range of these culture-specific subsistence and settlement patterns.

Interactions between members of these two traditions likely occurred on a regular basis, and recent cultural resource management (CRM) archaeology north and west of London, has identified a number of early Late Woodland sites with evidence of occupation by both. Examining the material culture excavated from sites within this region, referred to by Ferris and Wilson (2009) as the southwestern Ontario archaeological borderland, will be instrumental for understanding the nature of the interactions occurring between these communities and is the subject of ongoing research by archaeologists at Golder Associates Inc. and The University of Western Ontario.

The analysis of four extensively fragmented Western Basin large mammal assemblages identified the community-specific processing and discard activities resulting in their formation, namely, the separation of cervid appendicular from axial bones prior to marrow and grease extraction. This demonstrated the valuable information contained within the indeterminate mammal fragments commonly recovered from lower Great Lakes archaeological contexts, and argues for detailed taphonomic analysis of at least a sample of these specimens in order to reconstruct their taphonomic history. Adjustments to Outram's (1998, 2001) methodology made the collection of bone size, type, and element data more efficient and an important addition to zooarchaeological analyses throughout the Northeast.

The utility of collecting bone burning data (Stiner et al. 1995) was also demonstrated, especially in the identification of the differential treatment of cervid carcass portions during processing, cooking, and disposal. It too is easy to score, and as such, should also be added to the arsenal of characteristics recorded by faunal analysts working in the region.

Zooarchaeology

Seasonality studies, which are important for understanding prehistoric and historic site use and broad-scale regional patterns of mobility, have decreased in popularity over the past two decades. Most 21st century reports and articles only mention this important element briefly in their reconstructions of the subsistence and settlement patterns of past human groups. This study demonstrates the

utility of such an approach in developing and testing models of precontact native group mobility and social organization in the lower Great Lakes region. Family and species presence *and* abundance data, often all that is available to northeastern zooarchaeologists, were combined to identify faunal procurement foci at individual sites, as well as to estimate the approximate period and length of a single site occupation.

For each Western Basin site examined, a graph ranking the identified taxa by abundance and illustrating their annual availability was created (Appendix C). From this information, the approximate timing of the hunting and fishing activities occurring at a given site was suggested. The data from the 10 examined sites were then combined to reconstruct the seasonal locations of southwestern Ontario's Western Basin peoples, and hence, their annual mobility within the region between A.D. 800 and 1400. This technique is especially useful in the Great Lakes region given the prevalence of fish and migratory birds occupying it. These species are generally only available to humans for a limited period of time throughout the year, improving our seasonality estimates.

Subsistence Studies

The ethnographic and archaeological literature abounds with studies of foraging and complex agricultural groups. While there has been a longstanding interest in those communities with subsistence strategies somewhere in between (see Smith 2001, 2005), the opportunities to study them have been limited. This emphasizes the importance of the findings presented here on the subsistence and settlement approaches of two archaeological traditions engaging in a transitional mixed economy. During the 800 years of interest, both Western Basin and Iroquoian groups grew domestic crops, collected wild plants, hunted, and fished. The zooarchaeological data demonstrate, however, that their approaches to these tasks differed greatly; Western Basin peoples moved across southwestern Ontario during both the warm and cold seasons to exploit fish, waterfowl, cervids, rodents, raccoons, and terrestrial birds, while Iroquoians were more sedentary, and procured species that were available closer to their settlements.

Although these different hunting and fishing foci were maintained over time, both groups diversified their faunal subsistence base between A.D. 1000 and 1200, likely reflecting a simultaneous increase in the amount of labour devoted to domestic crop production. This strategy mirrors that of southern European and western Asian Middle and Upper Palaeolithic communities (Flannery 1969; Stiner 2001; Stiner et al. 2000; Stutz et al. 2009).

The faunal analyses conducted as part of this research programme also demonstrated that although bone marrow and grease extraction is most commonly observed among hunting and gathering populations (e.g., Binford 1978; Bunn 1993; Oliver 1993; Outram 1998; Prince 2007), it is not restricted to them. Bone grease greatly contributed to the Western Basin diet, and was efficiently collected within a short period following the kill. Further, bone marrow and grease were not just starvation foods (e.g., Speth and Spielmann 1983; Yellen 1991) sought during the most difficult parts of the year; they were preferred by members of this community, and likely were key ingredients in Western Basin cuisine. As such, evidence of extensive processing of large mammal carcasses must be examined at multiple sites and over a broader time period for a given community before assuming that it reflects resource stress.

Directions for Future Research

This study has identified numerous avenues in need of further investigation. While only those relevant to the primary subject matter, the subsistence and settlement patterns of Late Woodland communities in northeastern North America, are described here, this dissertation has illustrated the necessity of incorporating zooarchaeological data into reconstructions of past groups' use and view of the environment. The additional information that can be derived from the application of new analytical techniques (e.g., Outram 1998, 2001) and interpretive approaches to southwestern Ontario faunal assemblages was illustrated. While the focus here was on taphonomic questions, there is also great potential for these data to provide insights into the spiritual realm, group and community social organization, and inter-tradition relations.

Broadening the Late Woodland Archaeological Database: Verifying Subsistence and Settlement Trends in the Northeast

The patterns of group mobility and the noted faunal family and species preferences of the Western Basin and Iroquoian communities occupying southwestern Ontario need verification. As additional sites are identified and investigated over the next several decades, their zooarchaeological assemblages will be compared to the summaries provided here. These data will likely: (1) provide further insight into the flexibility and longevity of the Western Basin annual subsistence round; (2) identify additional Western Basin and Iroquoian settlement types within the region; (3) clarify the mobility patterns of these groups across southwestern Ontario over time; and (4) shed light on the nature of the interactions between these communities from A.D. 800 to 1600. New floral data will help to pinpoint when and where maize was first introduced into the lower Great Lakes region and identify when each Late Woodland community intensified its production of introduced domestic crops.

Now that we have a reasonable understanding of the settlement and subsistence patterns of the Western Basin peoples occupying southwestern Ontario, it would be interesting to see how they compare with their kin across the border in Michigan and Ohio. Besides Stothers and colleagues' (e.g., Stothers 1999; Stothers and Abel 2002; Stothers and Bechtel 2000; Stothers et al. 1994) broad-scale theoretical research, very few site reports describing Western Basin components from the American side of the modern border have been published in the past three decades. Given the increase in CRM archaeology throughout the lower Great Lakes region during this time, collections and reports likely exist. Tracking them down will help to shed further light on the variability within lower Great Lakes Late Woodland subsistence strategies.

The extent of subsistence variability during this temporal period should also be investigated for other Iroquoian groups in the region, namely those occupying southcentral Ontario, New York State, and Pennsylvania. Researchers still need to synthesize the faunal data from these regions. While many Iroquoian faunal assemblages have been reported on in the literature, every attempt should be made to include as much of the unpublished data as possible.

Examining the Timing of Fish Capture, Processing, and Transport

The importance of fish to the Western Basin subsistence economy opens interesting avenues for further research. An examination of fish element representation and size at different sites would shed further light on the timing and location of capture for each taxon, historical changes in average fish size, and the nature and location of fish processing and storage (Needs-Howarth 1999).

Exploring the Longevity of Lower Great Lakes Grease Processing Activities

As was previously noted, a high degree of fragmentation commonly characterizes the large mammal assemblages recovered in the study region. While some researchers have provided bone fragment size ranges, no previous attempts have been made to quantify the extent of the fragmentation or to identify its causes. The methodology outlined in this study could be applied to additional Western Basin assemblages to verify the processing trends noted here. Iroquoian cervid assemblages should also be examined in order to determine whether they had a similar tradition of intensive marrow and grease exploitation.

This dissertation represents an important starting point from which to develop future syntheses of faunal data throughout the Great Lakes region, and on a larger-scale, the entire Northeast. The expansive datasets collected over the past several decades in this part of the continent should now be examined at the regional level in order to address the research questions raised here. It is time to expand our analyses of individual sites to examine how the activities conducted at them fit into broader subsistence and settlement patterns, which can be used to reconstruct the annual mobility of the peoples who occupied northeastern North America between A.D. 800 and 1600.

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APPENDIX A: Western Basin and Ontario Iroquoian Tradition Faunal Datasets

Site Name Abbreviation Key

Western Basin Sites	Iroquoian Sites
SI = Sibelius	CB = Cayuga Bridge
VB = Van Bemmel	SF = Stratford Flats
MO = Montoya	PO = Porteous
IA = Inland Aggregates West Location 12	VN = Van Besien
DY = Dymock	KE = Kelly
RR = Robson Road	BO = Boisclair
CL = Cherry Lane	DW = DeWaele
BC = Bruner-Colasanti	YA = Yaworski
LS = La Salle-Lucier	CA = Calvert
SH = Sherman	BK = Berkmortel
LI = Liahn I	LT = Little
LB = Libby	RO = Roeland
DB = Dobbelaar	UR = Uren
	GU = Gunby
	BE = Bennett
	MR = Myers Road
	SC = Scout
	HR = H&R
	UN = Unick
	CY = Chypchar
	RF = Rife
	WB = Winking Bull
	IT = Itldu
	VE = Van Eden
	AC = Acheson
	CR = Crawford Lake
	PI = Pipeline
	FN = Finch
	SK = Skinner
	NO = Norton
	DA = Day
	IE = Ivan Elliot
	HA = Harrietsville
	SL = Sluyter
	UB = Upper Bluff Pond
	RT = Red Turtle
	BA = Bradley Avenue
	CO = Coleman
	RA = Raymond Reid
	CV = Cleveland

APPENDIX A *continued*

Table I. Number of Specimens by Class

Western Basin

Class	SI	VB	MO	IA	DY	RR	CL	BC	LS	SH	LI	LB	DB
M	716	3744	6117	2190	6810	707	2763	8536	78	5516	6340	7741	477
F	1	1	0	83	3414	5778	568	168	934	44	5391	4986	4197
B	1	2	2	0	25	6	4	161	55	5	423	235	149
R	0	5	4	0	28	13	0	0	22	1	59	65	35
A	0	0	0	0	13	6	1	15	0	0	0	19	2
MU	0	12	3	2	57	7	7	24	0	5	186	73	78
S	0	0	1	0	0	0	0	44	4	0	500	0	249
IN	9	3	9	8	268	14	39	12649	660	28	1518	2560	1146
Total	727	3767	6136	2283	10615	6531	3382	21597	1753	5599	14417	15679	6333
ID	**718**	**3764**	**6127**	**2275**	**10347**	**6517**	**3343**	**8948**	**1093**	**5571**	**12899**	**13119**	**5187**

Note: M = mammal, F = fish, B = bird, R = reptile, A = amphibian, MU = mussel, S = snail, C = crustacean, IN = indeterminate, ID = total of identified categories.

APPENDIX A *continued*

Table I continued

Iroquoian

Class	CB	SF	PO	VN	KE	BO	DW	YA	CA	BK	LT	RO	UR	GU
M	551	210	1089	4275	2258	1107	1039	561	43981	3037	660	2173	2688	9106
F	18	16	1480	415	7	616	1265	1	1797	101	1	92	656	4692
B	5	0	66	121	23	23	406	4	182	0	13	8	217	1114
R	1	2	54	76	4	2	23	0	71	16	0	0	28	56
A	0	0	63	7	0	0	91	0	0	0	0	0	22	55
MU	Y	1	Y	22	0	7	0	0	19	0	0	0	0	46
S	0	8	1	51	0	2	0	0	1	0	0	0	0	9
MO	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IN	0	5	2	0	0	18	6	0	1597	0	0	0	0	24
Total	575	242	2755	4967	2292	1775	2830	566	47648	3154	674	2273	3611	15102
ID	**575**	**237**	**2753**	**4967**	**2292**	**1757**	**2824**	**566**	**46051**	**3154**	**674**	**2273**	**3611**	**15078**

Class	BE	MR	SC	HR	UN	CY	RF	WB	IT	VE	AC	CR	PI
M	2006	3612	147	182	394	389	523	952	217	224	112	677	199
F	11	1454	44	28	47	101	3	243	21	9	7	93	80
B	40	141	19	6	19	148	16	433	11	3	15	52	50
R	33	165	10	8	18	53	6	54	2	2	17	14	4
A	182	98	0	2	0	49	0	6	0	0	0	195	0
MU	1	44	1	0	3	70	0	16	10	5	50	5	10
S	0	0	0	0	0	0	0	0	0	0	0	0	5
MO	0	0	0	0	0	0	0	0	0	0	0	0	0
C	0	0	0	0	0	0	0	0	0	0	0	0	0
IN	0	389	0	0	0	0	0	0	0	0	0	0	0
Total	2273	5903	221	226	481	810	548	1704	261	243	201	1036	348
ID	**2273**	**5514**	**221**	**226**	**481**	**810**	**548**	**1704**	**261**	**243**	**201**	**1036**	**348**

Class	FN	SK	NO	DA	IE	HA	SL	UB	RT	BA	CO	RA	CV
M	164	615	218	229	272	1791	349	351	154	755	345	252	5258
F	201	93	6	146	44	366	223	5189	16	544	194	33	766
B	48	24	3	16	38	35	24	122	16	14	19	22	30
R	0	3	1	1	6	15	2	2540	12	137	52	3	43
A	7	8	0	37	0	116	3	15	4	35	193	0	21
MU	6	86	5	14	5	108	8	7	64	21	0	0	251
S	0	149	0	0	0	150	0	5	0	0	0	0	987
MO	0	0	0	0	0	0	0	0	0	0	0	0	3
C	0	0	0	0	0	0	0	0	0	0	0	0	1
IN	0	101	0	103	0	53	1807	1924	0	1151	0	0	59
Total	426	1079	233	546	365	2634	2416	10153	266	2657	803	310	7419
ID	**426**	**978**	**233**	**443**	**365**	**2581**	**609**	**8229**	**266**	**1506**	**803**	**310**	**7360**

APPENDIX A *continued*

Table II. Mammals

Western Basin

Mammal	SI	VB	MO	IA	DY	RR	CL
Moose	2	0	0	0	0	0	0
Elk	2	0	0	0	2	0	0
White-tailed deer	69	257	542	307	489	394	19
Large cervid	0	0	0	1	0	0	0
Cervid	1	0	35	0	71	0	0
Artiodactyl	0	0	0	0	0	0	0
Leporid	0	0	0	0	0	0	0
Beaver	0	0	0	0	27	0	0
Flying squirrel	0	0	0	0	0	0	0
Woodchuck	1	0	1	0	135	0	0
Eastern gray squirrel	0	12	0	0	17	2	60
Eastern chipmunk	0	2	2	0	30	0	40
Red squirrel	0	0	0	0	0	0	0
Large squirrel	0	0	0	0	0	0	0
Squirrel	0	0	0	0	0	0	0
Muskrat	0	7	1	0	0	3	0
Deer mouse	0	0	0	0	1	3	0
Meadow vole	0	0	0	0	4	2	2
Vole	0	0	0	2	0	0	0
House mouse	0	0	0	0	0	0	0
Small rodent	0	0	0	0	0	0	0
Small to medium rodent	0	0	0	0	0	0	0
Medium rodent	0	0	3	0	0	0	0
Medium to large rodent	0	0	0	0	0	0	0
Large rodent	0	0	0	0	0	0	0
Rodent	0	0	0	0	0	0	0
North American porcupine	0	0	0	0	0	0	0
Northern short-tailed shrew	0	0	0	0	0	0	2
Eastern mole	0	0	0	0	0	0	0
Domestic dog	0	0	0	0	458	0	33
***Canis* sp.**	0	0	1	33	2	0	1
Common gray fox	0	0	0	0	0	0	0
Red fox	0	0	0	0	0	0	0
Fox	0	0	0	0	0	0	0
Small canid	0	0	0	0	0	0	0
Medium canid	0	0	0	0	0	0	0
Canid	0	0	0	1	0	0	0
Black bear	0	0	1	1	11	0	0
Northern raccoon	2	42	3	0	67	117	35
Northern river otter	0	5	0	0	0	0	0
Long-tailed weasel	0	0	0	0	0	0	0
American marten	0	0	0	0	0	0	0
American mink	0	0	0	0	0	0	0
Medium mustelid	0	0	0	0	0	0	0
Mustelid	0	0	1	0	0	0	0

APPENDIX A *continued*

Table II continued

Mammal	BC	LS	SH	LI	LB	DB
Moose	0	0	0	0	0	0
Elk	0	0	0	1	2	1
White-tailed deer	686	8	317	461	526	2
Large cervid	0	0	0	139	0	1
Cervid	37	0	0	0	0	1
Artiodactyl	3	0	0	0	0	0
Leporid	0	0	10	0	13	0
Beaver	0	0	0	7	16	0
Flying squirrel	0	0	0	1	0	0
Woodchuck	1	0	13	2	6	0
Eastern gray squirrel	351	1	11	5	100	4
Eastern chipmunk	2	0	0	18	9	0
Red squirrel	0	0	0	0	5	0
Large squirrel	0	0	0	4	0	0
Squirrel	0	1	0	0	0	0
Muskrat	8	3	0	900	71	123
Deer mouse	0	0	0	0	0	0
Meadow vole	0	0	0	0	0	0
Vole	0	0	0	3	0	0
House mouse	0	1	0	3	0	1
Small rodent	0	0	0	7	0	11
Small to medium rodent	0	0	0	1	0	3
Medium rodent	0	0	0	22	0	8
Medium to large rodent	0	0	0	1	0	0
Large rodent	0	0	0	2	0	2
Rodent	0	2	0	13	0	3
North American porcupine	0	0	0	2	0	0
Northern short-tailed shrew	0	0	0	9	0	0
Eastern mole	1	0	0	0	0	0
Domestic dog	0	0	0	0	212	0
***Canis* sp.**	4	0	0	13	0	49
Common gray fox	5	0	0	0	0	0
Red fox	0	0	0	0	0	1
Fox	0	0	0	0	5	0
Small canid	0	0	0	1	0	0
Medium canid	0	0	0	3	0	0
Canid	0	0	0	1	1	0
Black bear	87	0	0	2	6	2
Northern raccoon	62	5	67	18	94	4
Northern river otter	0	0	0	0	4	0
Long-tailed weasel	0	0	0	0	1	0
American marten	18	0	0	0	0	0
American mink	8	0	0	0	1	0
Medium mustelid	0	0	0	2	0	0
Mustelid	1	0	0	0	0	0

APPENDIX A *continued*

Table II continued

Mammal	SI	VB	MO	IA	DY	RR	CL	BC	LS	SH	LI	LB	DB
***Lynx* sp.**	0	0	0	0	0	0	0	1	0	0	0	10	0
Small carnivore	0	0	0	0	0	0	0	0	0	0	1	0	0
Medium carnivore	0	0	0	0	0	0	0	0	0	0	24	0	3
Medium to large carnivore	0	0	0	0	0	0	0	0	0	0	3	0	0
Carnivore	0	0	0	0	0	0	0	21	1	0	0	0	0
Small mammal	0	0	2	0	0	0	0	13	0	0	172	0	67
Small to medium mammal	0	0	0	0	0	0	0	27	0	0	296	0	2
Medium mammal	162	1	13	4	0	0	0	29	0	0	140	27	26
Medium to large mammal	456	0	5461	1185	0	0	0	1889	0	0	3067	0	148
Large mammal	19	7	19	655	0	5	0	850	0	0	325	203	3
Mammal	2	3411	32	1	5496	181	2571	4432	56	5098	671	6429	12
Total	**716**	**3744**	**6117**	**2190**	**6810**	**707**	**2763**	**8536**	**78**	**5516**	**6340**	**7741**	**477**

APPENDIX A *continued*

Table II continued

Iroquoian

Mammal	CB	SF	PO	VN	KE	BO	DW	YA	CA	BK
Moose	0	0	1	0	0	0	0	0	0	0
Elk	0	0	0	2	0	0	0	0	0	0
cf. Elk	1	0	0	0	0	0	0	0	0	0
White-tailed deer	140	44	19	2059	145	214	53	423	8258	471
Deer	0	0	0	0	0	0	0	0	0	0
Caribou	0	0	0	0	0	0	0	0	0	0
Large cervid	0	0	0	0	0	0	0	0	0	0
Cervid	0	0	0	7	2	3	1	0	140	0
Artiodactyl	0	0	0	0	0	0	0	0	0	0
Snowshoe hare	0	0	0	3	2	0	0	2	0	7
Eastern cottontail	0	0	0	27	0	0	0	0	13	0
cf. Eastern cottontail	0	0	0	0	0	0	0	0	0	0
Leporid	0	0	0	0	3	1	0	0	11	0
Beaver	5	0	34	163	2	0	42	0	96	0
Flying squirrel	0	0	0	0	0	0	0	0	0	0
Woodchuck	1	0	11	114	1	0	55	3	9	0
Eastern gray squirrel	32	17	422	63	7	17	72	2	16	0
Eastern chipmunk	0	1	16	6	1	19	41	0	52	0
Red squirrel	0	0	26	2	0	0	13	1	2	0
Squirrel	0	0	0	0	0	0	1	0	0	0
White-footed mouse	0	0	0	0	0	0	0	0	0	0
Deer mouse	0	0	0	0	0	0	0	0	0	0
***Peromyscus* sp.**	0	0	0	0	0	0	0	0	0	1
Murid	0	0	0	0	0	0	0	0	0	0
Meadow vole	0	0	0	0	0	0	0	0	12	0
Vole	0	0	0	0	0	0	0	0	0	0
Muskrat	0	0	28	6	4	0	14	2	5	0
House mouse	0	0	0	0	0	0	0	0	7	0
Meadow jumping mouse	0	0	0	0	0	0	0	0	0	0
Rodent	0	0	0	1	0	0	0	0	0	0
North American porcupine	0	0	3	10	0	0	1	0	3	0
Northern short-tailed shrew	0	0	0	0	0	1	0	0	1	0
Star-nosed mole	0	0	0	0	0	0	0	0	0	0
Hairy-tailed mole	0	0	0	0	0	0	0	0	6	0
Mole	0	0	0	0	0	0	0	0	0	0
Domestic dog	0	0	0	255	0	0	11	2	0	5
Coyote	0	0	0	0	0	0	0	0	0	0
Gray wolf	0	0	0	3	0	0	0	0	0	0
***Canis* sp.**	0	0	9	1	0	0	0	0	0	0
Common gray fox	0	0	0	1	0	0	0	0	1	0
Red fox	0	0	0	2	0	0	2	1	0	0
Fox	0	0	0	0	0	0	0	0	0	0
Medium canid	0	0	0	0	0	0	0	0	0	0
Canid	0	0	0	0	1	0	3	1	2	0
Black bear	1	3	15	22	0	0	7	6	152	0

APPENDIX A *continued*

Table II continued

Mammal	LT	RO	UR	GU	BE	MR	SC	HR	UN	CY
Moose	0	0	0	0	0	0	0	0	0	0
Elk	0	0	0	0	4	0	0	3	0	0
cf. Elk	0	0	0	0	0	0	0	0	0	0
White-tailed deer	449	120	577	1351	1834	404	34	133	328	4
Deer	0	0	435	0	0	0	0	0	0	0
Caribou	0	0	2	0	0	0	0	0	0	0
Large cervid	0	0	0	0	0	0	0	0	0	0
Cervid	0	0	483	125	0	84	0	0	0	3
Artiodactyl	0	0	0	0	0	0	0	0	0	0
Snowshoe hare	0	2	8	0	4	2	1	0	0	0
Eastern cottontail	0	0	0	3	2	33	0	1	0	1
cf. Eastern cottontail	0	0	0	0	0	0	0	0	0	0
Leporid	0	0	0	1	0	1	0	0	0	3
Beaver	0	0	76	26	5	18	16	14	3	28
Flying squirrel	0	0	0	0	0	0	0	0	0	0
Woodchuck	0	0	18	8	27	37	24	5	16	54
Eastern gray squirrel	158	1	59	207	14	92	6	3	14	159
Eastern chipmunk	27	0	9	79	17	45	2	0	0	14
Red squirrel	0	0	9	16	7	17	0	0	0	0
Squirrel	0	0	4	0	0	3	0	0	0	1
White-footed mouse	0	0	0	0	0	0	0	0	0	0
Deer mouse	2	0	0	0	0	0	0	0	0	0
***Peromyscus* sp.**	0	2	5	3	0	1	0	0	0	6
Murid	0	0	0	0	0	0	0	1	0	0
Meadow vole	0	0	0	4	0	0	0	0	0	0
Vole	0	0	0	0	0	0	0	0	0	0
Muskrat	0	0	4	28	8	14	15	1	3	12
House mouse	0	0	0	0	0	0	0	0	0	0
Meadow jumping mouse	0	0	0	0	0	0	0	0	0	0
Rodent	0	0	6	2	0	0	0	0	0	0
North American porcupine	0	0	0	2	0	3	1	2	0	0
Northern short-tailed shrew	0	0	0	0	1	0	0	0	0	0
Star-nosed mole	0	0	0	0	0	0	0	0	0	0
Hairy-tailed mole	0	0	0	0	0	0	0	0	0	0
Mole	0	0	0	0	0	0	0	0	0	0
Domestic dog	0	0	2	10	26	31	27	4	3	26
Coyote	0	0	0	0	0	0	0	0	0	0
Gray wolf	0	0	2	9	0	5	0	0	1	0
***Canis* sp.**	0	0	7	6	0	27	9	2	14	14
Common gray fox	0	0	0	0	0	9	1	0	0	6
Red fox	0	0	9	1	4	2	1	0	0	1
Fox	0	0	0	4	0	0	0	0	0	0
Medium canid	0	0	0	0	0	0	0	0	0	0
Canid	0	1	1	0	0	2	0	0	0	33
Black bear	0	0	13	11	23	3	7	2	10	12

APPENDIX A *continued*

Table II continued

Mammal	RF	WB	IT	VE	AC	CR	PI	FN	SK	NO
Moose	1	3	8	0	2	1	0	0	0	0
Elk	4	5	0	0	0	0	1	0	0	0
cf. Elk	0	0	0	0	0	0	0	0	0	0
White-tailed deer	350	340	89	184	52	437	32	34	68	203
Deer	0	0	0	0	0	0	0	0	0	0
Caribou	1	0	0	0	0	0	0	0	0	0
Large cervid	0	0	0	0	0	0	0	6	0	0
Cervid	0	14	0	5	0	4	0	0	0	6
Artiodactyl	0	0	0	0	0	0	0	0	0	1
Snowshoe hare	0	5	1	0	1	0	0	0	0	0
Eastern cottontail	2	3	0	1	1	0	0	0	0	0
cf. Eastern cottontail	0	0	0	0	0	0	0	0	0	0
Leporid	0	0	0	0	0	0	0	0	1	0
Beaver	8	24	10	0	1	5	1	1	0	0
Flying squirrel	0	0	0	0	0	0	0	0	0	0
Woodchuck	39	63	29	3	8	15	1	0	0	1
Eastern gray squirrel	17	175	14	2	23	83	42	16	2	2
Eastern chipmunk	7	38	0	0	2	40	0	3	1	0
Red squirrel	7	17	0	0	0	17	2	6	1	1
Squirrel	0	0	4	0	0	0	0	0	1	0
White-footed mouse	0	0	0	0	0	4	0	0	0	0
Deer mouse	0	1	0	0	0	0	0	0	0	0
***Peromyscus* sp.**	2	6	0	0	0	1	0	0	0	0
Murid	0	0	0	0	0	0	0	0	0	0
Meadow vole	0	8	0	0	0	0	0	0	0	0
Vole	1	4	0	0	0	3	0	0	0	0
Muskrat	17	58	0	0	0	9	0	11	0	2
House mouse	0	0	0	0	0	0	0	0	0	0
Meadow jumping mouse	0	0	0	0	0	0	0	0	0	0
Rodent	0	0	0	0	0	0	0	0	0	0
North American porcupine	0	1	6	0	0	0	0	0	0	0
Northern short-tailed shrew	0	0	0	0	0	4	0	0	0	0
Star-nosed mole	0	0	0	0	0	0	0	0	0	0
Hairy-tailed mole	0	0	0	0	0	0	0	0	0	0
Mole	0	0	0	0	0	0	0	0	0	0
Domestic dog	0	124	44	0	6	0	0	7	0	0
Coyote	0	0	0	0	0	0	0	0	0	0
Gray wolf	0	0	0	1	0	0	0	0	0	0
***Canis* sp.**	45	3	0	22	13	39	0	3	0	1
Common gray fox	2	0	0	0	0	0	0	0	1	0
Red fox	0	13	0	2	0	5	0	49	1	0
Fox	0	0	0	0	0	0	0	0	0	0
Medium canid	0	0	0	0	0	0	0	0	0	0
Canid	0	0	0	0	0	0	23	0	4	0
Black bear	8	11	1	1	1	4	1	0	0	1

APPENDIX A *continued*

Table II continued

Mammal	DA	IE	HA	SL	UB	RT	BA	CO	RA	CV
Moose	0	0	0	0	0	0	0	0	0	7
Elk	0	1	0	0	0	0	0	0	7	290
cf. Elk	0	0	0	0	0	0	0	0	0	0
White-tailed deer	8	4	64	4	3	3	45	27	140	2886
Deer	0	0	0	0	0	0	0	0	0	0
Caribou	0	0	0	0	0	0	0	0	0	0
Large cervid	0	0	0	0	0	0	0	0	0	0
Cervid	0	0	0	0	0	0	0	0	0	102
Artiodactyl	0	0	0	0	0	0	0	0	0	0
Snowshoe hare	0	26	0	0	0	1	0	0	0	4
Eastern cottontail	0	9	10	0	0	7	0	2	0	53
cf. Eastern cottontail	0	0	0	0	0	0	0	0	0	0
Leporid	0	0	0	1	0	0	0	0	0	7
Beaver	2	16	6	1	0	3	3	27	9	135
Flying squirrel	0	1	0	0	0	0	0	0	0	0
Woodchuck	10	91	99	13	2	32	5	82	18	59
Eastern gray squirrel	12	15	4	15	0	27	18	24	5	37
Eastern chipmunk	8	17	4	0	32	5	4	13	0	4
Red squirrel	0	1	2	0	0	2	0	4	0	3
Squirrel	0	0	2	0	0	0	2	0	0	0
White-footed mouse	0	0	0	0	0	0	0	0	0	0
Deer mouse	0	0	0	0	0	0	0	0	0	0
***Peromyscus* sp.**	0	3	1	0	13	0	0	3	0	0
Murid	0	0	0	0	0	0	0	0	0	0
Meadow vole	0	0	2	0	21	0	0	32	0	0
Vole	0	0	0	0	0	0	0	1	1	0
Muskrat	1	23	5	13	267	0	8	36	0	6
House mouse	0	0	0	0	0	0	0	0	0	0
Meadow jumping mouse	0	0	0	0	1	0	0	0	0	0
Rodent	0	0	0	0	0	0	0	0	0	0
North American porcupine	0	1	0	0	0	0	0	0	0	0
Northern short-tailed shrew	0	1	0	0	6	0	0	0	0	0
Star-nosed mole	0	0	0	0	0	0	0	0	0	0
Hairy-tailed mole	0	0	0	0	0	0	0	0	0	0
Mole	0	0	0	0	0	2	0	0	0	0
Domestic dog	3	32	0	11	0	30	3	41	0	325
Coyote	0	0	0	0	0	0	0	0	0	0
Gray wolf	0	2	0	0	0	1	0	0	0	14
***Canis* sp.**	0	0	0	0	0	37	0	1	17	202
Common gray fox	0	0	0	0	0	0	0	0	0	1
Red fox	0	0	0	0	0	0	0	2	0	3
Fox	0	0	0	0	0	0	11	0	0	5
Medium canid	0	0	0	0	0	0	0	0	0	0
Canid	0	0	2	0	0	0	0	1	0	0
Black bear	4	16	11	5	0	3	1	41	44	130

APPENDIX A *continued*

Table II continued

Mammal	CB	SF	PO	VN	KE	BO	DW	YA	CA	BK	LT	RO	UR	GU	BE	MR	SC	HR	UN	CY
Northern raccoon	0	0	4	23	13	2	11	102	206	38	24	32	27	4	19	8	1	9	2	12
Striped skunk	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Northern river otter	0	0	0	6	0	0	0	8	19	0	0	0	0	3	2	0	0	1	0	0
American marten	0	0	1	5	0	0	1	0	19	0	0	0	8	1	1	6	0	0	0	0
Fisher	0	0	0	2	0	0	0	1	1	0	0	0	0	3	8	2	0	1	0	0
***Martes* sp.**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ermine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
American mink	0	0	2	1	0	0	0	0	0	0	0	0	0	1	0	3	0	0	0	0
***Mustela* sp.**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0
Mustelid	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	2	0	0	0
***Lynx* sp.**	0	0	2	0	0	0	0	0	37	0	0	0	0	0	0	0	0	0	0	0
Small carnivore	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Medium carnivore	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carnivore	0	0	0	5	0	0	7	7	22	0	0	0	0	2	0	0	0	0	0	0
Small mammal	0	0	0	0	12	0	0	0	0	0	0	0	43	207	0	0	0	0	0	0
Small to medium mammal	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Medium mammal	0	0	0	0	12	0	0	0	0	0	0	0	12	638	0	0	0	0	0	0
Medium to large mammal	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Large mammal	0	0	0	0	151	0	0	0	0	0	0	0	662	4189	0	0	0	0	0	0
Mammal	371	145	496	1486	1895	850	704	0	34887	2515	0	2015	207	2162	0	2757	0	0	0	0
Total	**551**	**210**	**1089**	**4275**	**2258**	**1107**	**1039**	**561**	**43981**	**3037**	**660**	**2173**	**2688**	**9106**	**2006**	**3612**	**147**	**182**	**394**	**389**

APPENDIX A *continued*

Table II continued

Mammal	RF	WB	IT	VE	AC	CR	PI	FN	SK	NO	DA	IE	HA	SL	UB	RT	BA	CO	RA	CV
Northern raccoon	7	13	10	1	2	1	1	8	0	0	2	4	16	8	1	1	12	5	0	162
Striped skunk	1	1	0	0	0	0	2	17	0	0	0	0	4	0	0	0	0	0	8	3
Northern river otter	2	10	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	5
American marten	1	4	0	0	0	0	0	1	0	0	0	4	0	0	0	0	0	2	0	2
Fisher	0	1	0	1	0	2	0	0	0	0	0	2	1	0	0	0	0	0	0	3
***Martes* sp.**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ermine	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
American mink	1	3	1	0	0	1	0	0	6	0	1	3	0	0	0	0	0	0	0	0
***Mustela* sp.**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mustelid	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
***Lynx* sp.**	0	2	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	3	7
Small carnivore	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
Medium carnivore	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0
Carnivore	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
Small mammal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Small to medium mammal	0	0	0	0	0	0	0	0	221	0	0	0	0	0	0	0	0	0	0	0
Medium mammal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Medium to large mammal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Large mammal	0	0	0	0	0	0	0	2	308	0	0	0	0	0	0	0	0	0	0	0
Mammal	0	0	0	0	0	0	93	0	0	0	177	0	1552	278	4	0	642	0	0	798
Total	**523**	**952**	**217**	**224**	**112**	**677**	**199**	**164**	**615**	**218**	**229**	**272**	**1791**	**349**	**351**	**154**	**755**	**345**	**252**	**5258**

APPENDIX A *continued*

Table III. Fish

Western Basin

Fish	SI	VB	MO	IA	DY	RR	CL
Pumpkinseed	0	0	0	0	0	0	0
***Lepomis* sp.**	0	0	0	0	0	0	0
Rock bass	0	0	0	0	0	45	0
Bass	0	0	0	0	8	11	1
Centrarchid	0	0	0	6	0	0	0
White bass	0	0	0	0	0	1	0
Freshwater drum	0	0	0	0	0	75	7
Yellow perch	0	0	0	0	0	190	2
***Sander* sp.**	0	0	0	0	954	261	5
Walleye	0	0	0	0	0	0	0
Percid	0	0	0	0	0	58	0
Perciformes	0	0	0	9	2	9	0
***Catostomus* sp.**	0	0	0	0	1	64	0
***Moxostoma* sp.**	0	0	0	0	12	1	0
Catostomid	0	1	0	5	2033	92	0
Bowfin	0	0	0	0	0	4	0
Lake sturgeon	0	0	0	0	0	9	0
***Esox* sp.**	0	0	0	0	0	0	0
Brown bullhead	0	0	0	0	0	0	5
Channel catfish	0	0	0	0	1	9	0
Stonecat	0	0	0	0	0	16	0
Ictalurid	0	0	0	0	26	1	0
Longnose gar	0	0	0	0	0	0	0
***Salvelinus* sp.**	0	0	0	0	0	0	0
Cisco/lake herring	0	0	0	0	0	0	23
Lake whitefish	0	0	0	0	0	2	26
***Coregonus* sp.**	0	0	0	0	0	0	0
Salmonid	0	0	0	0	0	0	0
Burbot	0	0	0	0	0	221	40
Small fish	0	0	0	0	0	0	0
Small to medium fish	0	0	0	0	0	0	0
Medium fish	0	0	0	25	0	0	0
Medium to large fish	0	0	0	35	0	0	0
Large fish	0	0	0	1	0	0	0
Fish	1	0	0	2	377	4709	459
Total	**1**	**1**	**0**	**83**	**3414**	**5778**	**568**

APPENDIX A *continued*

Table III continued

Fish	BC	LS	SH	LI	LB	DB
Pumpkinseed	0	0	0	0	3	0
***Lepomis* sp.**	0	0	0	16	0	6
Rock bass	0	2	0	0	21	0
Bass	3	2	0	0	57	0
Centrarchid	0	0	0	78	15	18
White bass	0	0	0	0	0	0
Freshwater drum	1	9	0	15	79	22
Yellow perch	8	7	0	15	21	0
***Sander* sp.**	0	2	1	32	444	49
Walleye	1	0	0	0	22	4
Percid	2	0	0	8	1	12
Perciformes	2	0	1	240	10	160
***Catostomus* sp.**	1	1	0	0	17	0
***Moxostoma* sp.**	0	0	0	0	3	0
Catostomid	0	0	20	1	48	3
Bowfin	0	17	0	504	45	95
Lake sturgeon	1	0	0	0	36	1
***Esox* sp.**	0	0	0	24	7	13
Brown bullhead	0	0	0	2	1	0
Channel catfish	0	0	0	1	10	0
Stonecat	0	0	0	0	0	0
Ictalurid	0	6	0	110	7	18
Longnose gar	0	0	0	0	1	0
***Salvelinus* sp.**	0	0	0	0	2	0
Cisco/lake herring	0	0	0	0	0	0
Lake whitefish	0	0	0	0	1	0
***Coregonus* sp.**	0	0	0	0	1009	2
Salmonid	0	0	0	0	84	0
Burbot	0	0	0	0	1	0
Small fish	0	0	0	49	0	108
Small to medium fish	0	0	0	85	0	1210
Medium fish	0	0	0	861	0	323
Medium to large fish	0	0	0	1729	0	728
Large fish	0	0	0	127	0	109
Fish	149	888	22	1494	3041	1316
Total	**168**	**934**	**44**	**5391**	**4986**	**4197**

APPENDIX A *continued*

Table III continued

Iroquoian

Fish	CB	SF	PO	VN	KE	BO	DW	YA	CA	BK
Pumpkinseed	0	0	0	3	0	0	0	0	0	0
Bluegill	0	0	0	0	0	0	0	0	0	0
***Lepomis* sp.**	0	0	0	0	0	0	0	0	0	0
Rock bass	0	0	7	2	0	0	0	0	9	0
***Pomoxis* sp.**	0	0	0	0	0	0	0	0	0	0
Largemouth bass	0	0	10	0	0	0	0	0	1	0
Smallmouth bass	0	0	28	0	0	0	0	0	0	0
Bass	0	1	13	12	0	0	0	0	6	0
Centrarchid	0	0	0	1	0	0	0	0	0	0
White bass	0	0	0	0	0	0	0	0	0	0
***Morone* sp.**	0	0	0	0	0	0	0	0	0	0
cf. *Morone* sp.	0	0	0	0	0	0	0	0	0	0
Freshwater drum	5	0	2	4	0	0	0	0	0	0
Yellow perch	0	0	2	5	0	0	0	0	2	0
***Sander* sp.**	0	0	92	20	0	0	0	0	3	0
Walleye	0	0	0	0	0	1	0	0	6	0
Sauger	0	0	0	0	0	0	0	0	0	0
Percid	0	0	0	2	0	0	0	0	1	0
Perciformes	0	0	0	0	0	0	0	0	0	0
Quillback	0	0	0	0	0	0	0	0	0	0
Longnose sucker	0	0	0	0	0	0	0	0	1	0
White sucker	0	0	0	0	0	0	0	1	0	0
***Catostomus* sp.**	0	3	31	0	0	248	0	0	417	0
Silver redhorse	0	0	0	0	0	0	0	0	0	0
Golden redhorse	0	0	0	0	0	0	0	0	77	0
Greater redhorse	0	0	0	0	0	0	0	0	0	0
***Moxostoma* sp.**	1	0	48	0	0	0	0	0	0	0
Catostomid	0	0	77	71	0	8	0	0	316	0
***Chrosomus* sp.**	0	0	0	0	0	3	0	0	0	0
Creek chub	0	0	0	0	0	0	0	0	0	0
cf. Creek chub	0	0	0	0	0	0	0	0	0	0
***Semotilus* sp.**	0	0	0	0	0	0	0	0	0	0
Cypriniformes	0	0	0	0	0	0	0	0	7	0
Bowfin	0	0	1	4	0	0	0	0	2	0
Lake sturgeon	1	0	3	5	0	0	0	0	2	0
Northern pike	0	0	0	0	0	0	0	0	0	0
***Esox* sp.**	0	0	0	1	0	1	0	0	2	0
Esocid	0	0	0	0	0	0	0	0	0	0
Yellow bullhead	0	0	0	0	0	0	0	0	0	0
Brown bullhead	0	0	21	0	0	0	0	0	4	0
Channel catfish	0	0	0	21	0	0	0	0	3	0
Stonecat	0	0	0	0	0	0	0	0	0	0
***Ictalurus* sp.**	0	0	34	0	0	0	0	0	0	0
Ictalurid	0	0	0	0	1	0	0	0	11	0
Longnose gar	0	0	0	1	0	0	0	0	0	0

APPENDIX A *continued*

Table III continued

Fish	LT	RO	UR	GU	BE	MR	SC	HR	UN	CY
Pumpkinseed	0	0	0	0	0	51	0	1	0	0
Bluegill	0	0	0	0	1	0	0	0	0	0
***Lepomis* sp.**	0	0	0	0	0	8	0	0	0	0
Rock bass	0	0	0	29	0	8	0	0	0	0
***Pomoxis* sp.**	0	0	0	0	0	0	0	0	0	0
Largemouth bass	0	0	0	0	0	16	0	7	0	3
Smallmouth bass	0	0	0	0	0	4	0	3	2	0
Bass	0	0	0	10	0	25	0	0	9	1
Centrarchid	0	0	0	14	0	33	2	0	0	0
White bass	0	0	0	0	0	0	0	0	0	0
***Morone* sp.**	0	0	0	0	0	0	1	0	0	0
cf. *Morone* sp.	0	0	0	0	0	0	0	0	0	0
Freshwater drum	0	0	0	0	1	2	0	0	0	0
Yellow perch	0	0	0	0	0	27	2	1	0	0
***Sander* sp.**	0	0	0	29	0	82	4	0	0	0
Walleye	0	0	0	0	0	4	0	0	2	2
Sauger	0	0	0	0	2	4	0	0	2	0
Percid	0	0	0	0	0	26	5	0	1	0
Perciformes	0	0	0	0	0	0	0	0	0	0
Quillback	0	0	0	0	0	2	0	0	0	0
Longnose sucker	0	0	0	0	0	11	0	1	0	0
White sucker	0	0	0	0	1	17	0	1	0	0
***Catostomus* sp.**	0	0	0	0	0	26	0	1	5	3
Silver redhorse	0	0	0	0	0	0	0	0	0	0
Golden redhorse	0	0	0	0	0	1	0	4	0	0
Greater redhorse	0	0	0	0	0	7	0	0	0	0
***Moxostoma* sp.**	0	0	0	10	0	33	0	0	0	0
Catostomid	0	0	0	0	0	9	0	0	1	0
***Chrosomus* sp.**	0	0	0	0	0	0	0	0	0	0
Creek chub	0	0	0	0	0	0	0	0	0	0
cf. Creek chub	0	0	0	0	0	0	0	0	0	0
***Semotilus* sp.**	0	0	0	0	0	0	0	0	0	0
Cypriniformes	0	0	0	0	0	0	0	0	0	3
Bowfin	0	0	0	52	0	3	1	0	5	4
Lake sturgeon	0	0	0	23	0	9	0	0	1	0
Northern pike	0	0	0	0	4	0	0	0	1	3
***Esox* sp.**	0	0	0	153	0	0	0	0	0	0
Esocid	0	0	0	0	0	0	2	0	0	0
Yellow bullhead	0	0	0	0	0	0	0	1	0	0
Brown bullhead	0	0	0	371	0	1	1	3	7	7
Channel catfish	0	0	0	8	0	1	7	1	6	0
Stonecat	0	0	0	0	0	0	0	0	0	0
***Ictalurus* sp.**	0	0	0	0	0	19	0	0	0	67
Ictalurid	0	0	0	14	2	0	19	2	1	0
Longnose gar	0	0	0	0	0	0	0	0	0	0

APPENDIX A *continued*

Table III continued

Fish	RF	WB	IT	VE	AC	CR	PI	FN	SK	NO
Pumpkinseed	0	7	0	0	0	0	0	0	0	0
Bluegill	0	0	0	0	0	0	0	0	0	0
***Lepomis* sp.**	0	0	0	0	0	0	0	2	0	0
Rock bass	0	0	0	0	0	0	0	0	0	1
***Pomoxis* sp.**	0	0	0	0	0	0	0	1	0	0
Largemouth bass	0	6	0	0	0	3	3	0	1	0
Smallmouth bass	0	11	0	0	0	4	0	1	0	1
Bass	0	0	0	0	0	5	0	1	0	0
Centrarchid	0	6	0	0	0	0	0	0	0	0
White bass	0	0	0	0	0	0	0	7	0	0
***Morone* sp.**	0	0	0	0	0	0	0	0	0	0
cf. *Morone* sp.	0	0	0	0	0	0	0	1	0	0
Freshwater drum	1	1	0	0	0	3	0	0	0	0
Yellow perch	0	5	0	1	0	4	0	3	0	0
***Sander* sp.**	0	0	0	0	0	7	0	72	0	0
Walleye	0	9	0	0	0	0	0	16	0	0
Sauger	0	3	0	2	0	0	0	43	0	0
Percid	0	0	0	0	1	0	0	0	1	0
Perciformes	0	0	0	0	0	0	0	0	0	0
Quillback	0	0	0	0	0	0	0	0	0	0
Longnose sucker	0	4	0	0	0	0	0	0	0	0
White sucker	0	1	0	0	0	0	0	2	0	0
***Catostomus* sp.**	0	19	0	1	0	16	0	0	4	0
Silver redhorse	0	8	0	0	0	0	0	0	0	0
Golden redhorse	0	0	0	0	0	0	0	0	0	0
Greater redhorse	0	4	0	0	0	0	0	0	0	0
***Moxostoma* sp.**	0	2	0	0	3	0	0	1	3	0
Catostomid	0	0	0	0	0	0	7	0	0	0
***Chrosomus* sp.**	0	0	0	0	0	0	0	0	0	0
Creek chub	0	0	0	0	0	0	0	3	0	0
cf. Creek chub	0	0	0	0	0	0	0	0	2	0
***Semotilus* sp.**	0	0	0	0	0	0	0	0	0	0
Cypriniformes	0	2	0	0	0	0	0	0	0	0
Bowfin	0	5	1	0	1	0	0	0	0	0
Lake sturgeon	0	0	4	0	0	0	0	0	0	0
Northern pike	0	0	0	0	0	1	0	0	0	0
***Esox* sp.**	0	0	0	0	0	0	0	0	0	0
Esocid	0	0	0	0	0	0	0	0	0	0
Yellow bullhead	0	16	0	0	0	0	0	5	0	0
Brown bullhead	0	24	1	2	0	0	2	0	0	1
Channel catfish	0	2	0	3	0	0	0	19	0	1
Stonecat	0	0	0	0	0	0	0	3	0	0
***Ictalurus* sp.**	0	90	15	0	1	0	0	9	2	0
Ictalurid	2	0	0	0	0	50	0	1	0	2
Longnose gar	0	3	0	0	0	0	0	0	0	0

APPENDIX A *continued*

Table III continued

Fish	DA	IE	HA	SL	UB	RT	BA	CO	RA	CV
Pumpkinseed	0	0	0	0	182	0	0	1	0	0
Bluegill	0	0	0	0	0	0	5	0	0	0
***Lepomis* sp.**	0	0	0	0	14	0	0	0	0	0
Rock bass	0	5	0	1	257	0	18	1	0	1
***Pomoxis* sp.**	0	0	0	0	0	0	0	0	0	0
Largemouth bass	0	0	0	0	0	0	0	0	0	3
Smallmouth bass	0	0	0	0	0	0	0	0	8	2
Bass	0	0	0	3	30	0	0	0	0	1
Centrarchid	2	0	0	0	4	0	0	0	0	0
White bass	0	0	0	0	0	0	0	0	0	0
***Morone* sp.**	0	0	0	0	0	0	0	0	0	0
cf. *Morone* sp.	0	0	0	0	0	0	0	0	0	0
Freshwater drum	0	0	4	0	18	0	0	0	0	26
Yellow perch	0	4	0	0	26	0	0	16	4	0
***Sander* sp.**	1	0	0	4	4	0	9	0	0	38
Walleye	0	12	0	0	4	3	0	0	0	0
Sauger	0	0	0	0	0	0	0	0	0	0
Percid	0	0	7	0	3	0	0	0	0	0
Perciformes	1	0	0	0	9	0	0	0	0	0
Quillback	0	0	0	0	0	0	0	0	0	0
Longnose sucker	0	0	0	0	0	0	0	3	0	5
White sucker	0	0	0	0	0	0	0	0	0	9
***Catostomus* sp.**	3	0	13	0	1	0	5	107	0	1
Silver redhorse	0	0	0	0	0	0	0	0	0	0
Golden redhorse	0	0	0	0	0	0	0	0	0	0
Greater redhorse	0	0	0	0	0	0	0	1	0	0
***Moxostoma* sp.**	0	0	1	0	0	2	1	3	0	44
Catostomid	23	0	0	7	0	0	17	2	0	117
***Chrosomus* sp.**	0	0	0	0	0	0	0	0	0	0
Creek chub	0	0	0	0	0	0	0	0	0	0
cf. Creek chub	0	0	0	0	0	0	0	0	0	0
***Semotilus* sp.**	0	0	0	0	0	0	0	39	0	0
Cypriniformes	0	0	1	0	1	0	4	0	12	0
Bowfin	0	0	0	2	51	4	1	0	0	0
Lake sturgeon	1	0	0	0	3	0	0	0	0	33
Northern pike	1	2	0	0	7	1	0	0	0	0
***Esox* sp.**	0	0	0	1	48	0	0	0	0	0
Esocid	0	0	0	0	0	0	0	0	5	0
Yellow bullhead	0	0	0	0	0	0	0	0	0	0
Brown bullhead	0	6	0	0	722	0	0	0	4	1
Channel catfish	0	5	10	0	1	0	16	0	0	5
Stonecat	0	0	0	0	0	0	0	4	0	0
***Ictalurus* sp.**	0	0	8	0	10	6	0	0	0	0
Ictalurid	7	0	0	0	0	0	11	11	0	2
Longnose gar	0	0	0	0	16	0	0	0	0	0

APPENDIX A *continued*

Table III continued

Fish	CB	SF	PO	VN	KE	BO	DW	YA	CA	BK	LT	RO	UR	GU	BE	MR	SC	HR	UN	CY
Lepisosteid	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Atlantic salmon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	4
Rainbow trout	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Brook trout	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0
Lake trout	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
***Salvelinus* sp.**	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Cisco/lake herring	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake whitefish	0	0	0	10	0	0	0	0	28	0	0	0	0	0	0	0	0	0	0	0
***Coregonus* sp.**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Salmonid	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	3	0	0	2	3
Burbot	0	1	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
American eel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Clupeiformes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Small to medium fish	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Large fish	0	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0	0
Fish	11	11	1111	243	4	353	1265	0	892	89	1	92	656	3979	0	1017	0	0	0	0
Total	**18**	**16**	**1480**	**415**	**7**	**616**	**1265**	**1**	**1797**	**101**	**1**	**92**	**656**	**4692**	**11**	**1454**	**44**	**28**	**47**	**101**

Table III continued

Fish	RF	WB	IT	VE	AC	CR	PI	FN	SK	NO	DA	IE	HA	SL	UB	RT	BA	CO	RA	CV
Lepisosteid	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Atlantic salmon	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rainbow trout	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brook trout	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake trout	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
***Salvelinus* sp.**	0	0	0	0	0	0	4	0	0	0	1	0	0	3	0	0	0	6	0	0
Cisco/lake herring	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0
Lake whitefish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
***Coregonus* sp.**	0	6	0	0	0	0	4	1	0	0	1	0	0	1	0	0	46	0	0	0
Salmonid	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Burbot	0	3	0	0	0	0	0	0	0	0	0	0	0	0	26	0	0	0	0	0
American eel	0	2	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0
Clupeiformes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Small to medium fish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Large fish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fish	0	0	0	0	0	0	60	0	80	0	105	0	322	201	3752	0	411	0	0	478
Total	**3**	**243**	**21**	**9**	**7**	**93**	**80**	**201**	**93**	**6**	**146**	**44**	**366**	**223**	**5189**	**16**	**544**	**194**	**33**	**766**

APPENDIX A *continued*

Table IV. Birds

Western Basin

Bird	SI	VB	MO	IA	DY	RR	CL	BC	LS	SH	LI	LB	DB
Passenger pigeon	0	0	0	0	2	1	0	0	0	0	0	80	0
Columbid	0	0	1	0	0	0	0	0	0	0	0	0	38
Wild turkey	0	0	0	0	15	0	1	56	0	5	2	3	0
Ruffed grouse	0	0	0	0	0	0	0	11	0	0	0	0	0
Grouse	0	0	0	0	0	0	0	0	0	0	0	1	0
Tetraonid	0	0	1	0	0	0	0	0	0	0	0	0	0
Swan	0	0	0	0	0	0	0	0	0	0	1	0	1
Canada goose	0	0	0	0	0	0	0	0	0	0	0	1	1
Lesser snow goose	0	0	0	0	0	0	0	1	0	0	0	0	0
Goose	0	0	0	0	0	0	0	2	0	0	2	1	0
Bufflehead	0	0	0	0	0	0	0	2	0	0	0	0	0
Small duck	0	0	0	0	0	0	0	0	0	0	3	0	0
Small to medium duck	0	0	0	0	0	0	0	0	0	0	3	0	0
Medium duck	0	0	0	0	0	0	0	0	0	0	73	1	4
Medium to large duck	0	0	0	0	0	0	0	0	0	0	14	0	0
Large duck	0	0	0	0	0	0	0	0	0	0	3	0	0
Duck	0	0	0	0	0	0	0	0	0	0	4	3	0
Loon	0	0	0	0	0	0	0	0	0	0	2	0	0
Grebe	0	0	0	0	0	0	0	0	0	0	2	0	0
***Phalocrocorax* sp.**	0	0	0	0	0	0	0	0	0	0	1	0	0
Small to medium aquatic bird	0	0	0	0	0	0	0	0	0	0	1	0	0
Medium aquatic bird	0	0	0	0	0	0	0	0	0	0	9	0	0
Medium to large aquatic bird	0	0	0	0	0	0	0	0	0	0	7	0	0
Large aquatic bird	0	0	0	0	0	0	0	0	0	0	2	0	0
Barred owl	0	0	0	0	0	0	2	11	12	0	0	0	0
Strigiformes	0	0	0	0	1	0	0	0	0	0	0	0	0
Northern goshawk	0	0	0	0	0	0	0	3	0	0	0	0	0
Sharp-shinned hawk	0	0	0	0	0	0	0	0	0	0	0	1	0
Red-tailed hawk	0	0	0	0	0	0	0	0	0	0	0	0	0
Hawk	0	0	0	0	0	0	0	1	0	0	0	0	0
Great blue heron	0	0	0	0	1	0	0	0	0	0	0	0	0
Common raven	0	0	0	0	0	0	0	0	0	0	0	1	0
Blue jay	0	0	0	0	0	4	0	0	0	0	0	0	0
Passeriformes	0	2	0	0	0	0	0	0	0	0	0	1	0
Small bird	0	0	0	0	0	1	0	0	0	0	4	1	18
Small to medium bird	0	0	0	0	0	0	0	0	0	0	40	0	15
Medium bird	1	0	0	0	0	0	0	0	0	0	119	6	24
Medium to large bird	0	0	0	0	0	0	0	0	0	0	39	1	42
Large bird	0	0	0	0	0	0	0	0	0	0	18	3	1
Bird	0	0	0	0	6	0	1	74	43	0	74	131	5
Total	**1**	**2**	**2**	**0**	**25**	**6**	**4**	**161**	**55**	**5**	**423**	**235**	**149**

APPENDIX A *continued*

Table IV continued

Iroquoian

Bird	CB	SF	PO	VN	KE	BO	DW	YA	CA	BK
Passenger pigeon	0	0	8	29	0	12	0	0	3	0
Columbid	0	0	0	0	0	0	0	0	0	0
Wild turkey	0	0	0	19	1	4	0	3	76	0
Ruffed grouse	0	0	5	4	0	0	0	1	0	0
Spruce grouse	0	0	0	0	2	0	0	0	0	0
Grouse	0	0	0	1	0	0	0	0	0	0
Tetraonid	0	0	0	0	0	0	0	0	6	0
***Colinus* sp.**	0	0	0	0	0	0	0	0	0	0
Phasianid	0	0	0	0	0	0	0	0	0	0
Tundra/Whistling swan	0	0	0	0	0	0	0	0	0	0
Canada goose	0	0	0	1	0	0	0	0	0	0
Goose	0	0	0	0	0	0	0	0	0	0
Wood duck	0	0	0	0	0	0	0	0	0	0
Northern shoveler	0	0	0	0	0	0	0	0	0	0
Blue-winged teal	0	0	0	0	0	0	0	0	0	0
Teal	0	0	0	0	0	0	0	0	0	0
Mallard	0	0	0	0	0	0	0	0	0	0
American black duck	0	0	0	0	0	0	0	0	0	0
***Anas* sp.**	0	0	0	0	0	0	0	0	0	0
Ring-necked duck	0	0	0	0	0	0	0	0	0	0
Aythinae	0	0	0	0	0	0	0	0	0	0
Bufflehead	0	0	0	1	0	0	0	0	0	0
Common goldeneye	0	0	1	0	0	0	0	0	0	0
***Bucephala* sp.**	0	0	0	0	0	0	0	0	0	0
Old squaw	0	0	1	1	0	0	0	0	0	0
Hooded merganser	0	0	1	1	0	0	0	0	0	0
White-winged scoter	0	0	0	0	0	0	0	0	0	0
Surf scoter	0	0	0	0	0	0	0	0	0	0
***Melanitta* sp.**	0	0	0	0	0	0	0	0	0	0
Common merganser	0	0	1	1	0	0	0	0	0	0
Red-breasted merganser	0	0	0	0	0	0	0	0	0	0
***Mergus* sp.**	0	0	0	0	0	0	0	0	0	0
Small duck	0	0	0	0	0	0	0	0	0	0
Medium duck	0	0	0	0	0	0	0	0	0	0
Large duck	0	0	0	0	0	0	0	0	0	0
Duck	0	0	0	0	0	1	0	0	0	0
Anserinae	0	0	0	0	0	0	0	0	0	0
Anatid	0	0	0	0	0	0	0	0	6	0
Common loon	0	0	0	1	0	0	0	0	0	0
Red-throated loon	0	0	1	0	0	0	0	0	0	0
Horned grebe	0	0	0	0	0	0	0	0	0	0
Red-necked grebe	0	0	2	0	0	0	0	0	0	0
***Podiceps* sp.**	0	0	0	0	0	0	0	0	0	0
Northern/yellow-shafted flicker	0	0	0	1	0	0	0	0	0	0
cf. Northern/yellow-shafted flicker	0	0	0	0	0	0	0	0	0	0

APPENDIX A *continued*

Table IV continued

Bird	LT	RO	UR	GU	BE	MR	SC	HR	UN	CY
Passenger pigeon	0	0	0	125	22	26	16	2	4	74
Columbid	0	0	0	0	0	1	1	0	2	0
Wild turkey	11	0	0	2	4	11	0	1	4	44
Ruffed grouse	2	0	0	0	4	14	0	1	0	15
Spruce grouse	0	0	0	0	0	0	0	0	0	1
Grouse	0	0	0	0	0	0	0	0	0	0
Tetraonid	0	0	0	0	0	0	0	0	0	1
***Colinus* sp.**	0	0	0	0	0	0	0	0	0	0
Phasianid	0	0	0	0	0	0	0	0	7	0
Tundra/Whistling swan	0	0	0	4	0	0	0	0	0	0
Canada goose	0	0	0	0	0	2	0	0	0	0
Goose	0	0	0	0	0	0	0	0	0	0
Wood duck	0	0	0	1	0	0	0	0	1	0
Northern shoveler	0	0	0	0	0	0	0	0	0	0
Blue-winged teal	0	0	0	0	0	0	0	0	0	0
Teal	0	0	0	1	0	0	0	0	0	0
Mallard	0	0	0	0	0	0	0	0	0	0
American black duck	0	0	0	0	0	0	0	0	0	0
***Anas* sp.**	0	0	0	0	0	0	0	0	0	0
Ring-necked duck	0	0	0	0	0	0	0	0	0	0
Aythinae	0	0	0	0	0	1	0	0	0	0
Bufflehead	0	0	0	0	1	0	0	0	0	0
Common goldeneye	0	0	0	3	0	0	0	0	0	0
***Bucephala* sp.**	0	0	0	1	0	0	0	0	0	0
Old squaw	0	0	0	0	0	2	0	0	0	4
Hooded merganser	0	0	0	0	1	0	0	0	0	0
White-winged scoter	0	0	0	0	0	0	0	0	0	0
Surf scoter	0	0	0	0	1	0	0	0	0	0
***Melanitta* sp.**	0	0	0	2	0	0	0	0	0	0
Common merganser	0	0	0	0	1	0	0	0	0	0
Red-breasted merganser	0	0	0	0	1	0	0	0	0	0
***Mergus* sp.**	0	0	0	0	0	0	0	0	0	0
Small duck	0	0	0	1	0	0	0	0	0	0
Medium duck	0	0	0	3	0	0	0	0	0	0
Large duck	0	0	0	4	0	0	0	0	0	0
Duck	0	0	0	0	0	0	0	0	0	0
Anserinae	0	0	0	0	0	0	0	0	0	0
Anatid	0	0	0	2	0	0	0	0	0	1
Common loon	0	0	0	0	0	1	0	0	0	3
Red-throated loon	0	0	0	0	0	0	0	0	0	0
Horned grebe	0	0	0	0	0	0	0	0	0	0
Red-necked grebe	0	0	0	0	0	0	0	0	0	0
***Podiceps* sp.**	0	0	0	0	0	0	0	0	0	0
Northern/yellow-shafted flicker	0	0	0	0	0	0	0	0	0	0
cf. Northern/yellow-shafted flicker	0	0	0	1	0	0	0	0	0	0

APPENDIX A *continued*

Table IV continued

Bird	RF	WB	IT	VE	AC	CR	PI	FN	SK	NO
Passenger pigeon	2	335	0	1	6	39	10	29	1	0
Columbid	0	0	0	0	0	0	0	0	0	0
Wild turkey	0	19	0	1	2	0	6	1	0	2
Ruffed grouse	5	37	0	0	1	6	1	12	6	0
Spruce grouse	0	0	0	0	0	0	0	0	0	0
Grouse	0	0	0	0	0	0	0	0	0	0
Tetraonid	0	0	0	0	0	0	0	0	0	0
***Colinus* sp.**	0	0	0	0	0	0	0	0	0	0
Phasianid	0	0	0	0	0	0	0	0	0	0
Tundra/Whistling swan	0	1	0	0	0	0	0	0	0	0
Canada goose	1	5	4	0	0	0	0	3	0	0
Goose	0	0	0	0	0	0	0	1	0	0
Wood duck	0	0	0	0	0	1	0	0	0	0
Northern shoveler	0	0	0	0	0	1	0	0	0	0
Blue-winged teal	0	0	0	0	0	0	0	0	0	0
Teal	0	0	0	0	0	0	0	0	0	0
Mallard	0	1	0	0	0	0	0	0	0	0
American black duck	0	0	0	0	0	0	0	0	0	0
***Anas* sp.**	0	3	0	0	0	0	0	0	1	0
Ring-necked duck	1	0	0	0	0	0	0	0	0	0
Aythinae	0	0	0	0	0	0	0	0	0	0
Bufflehead	0	0	0	0	0	0	0	0	0	0
Common goldeneye	0	0	0	0	0	0	0	0	0	0
***Bucephala* sp.**	0	0	0	0	0	0	0	0	0	0
Old squaw	0	0	0	0	0	0	1	0	0	0
Hooded merganser	0	1	0	0	0	0	0	0	0	0
White-winged scoter	0	0	0	0	0	0	1	0	0	0
Surf scoter	0	0	0	0	0	0	0	0	0	0
***Melanitta* sp.**	0	0	0	0	0	0	0	0	0	0
Common merganser	0	2	0	1	0	0	0	0	0	0
Red-breasted merganser	0	0	4	0	0	0	0	0	0	0
***Mergus* sp.**	0	0	0	0	0	1	0	0	0	0
Small duck	0	0	0	0	0	0	0	0	0	0
Medium duck	0	0	0	0	0	0	0	0	0	0
Large duck	0	0	0	0	0	0	0	0	0	0
Duck	0	0	0	0	0	0	0	0	0	0
Anserinae	0	0	0	0	0	0	0	0	0	0
Anatid	1	0	2	0	0	0	0	0	0	0
Common loon	0	0	1	0	0	0	0	0	0	0
Red-throated loon	0	2	0	0	0	0	0	0	0	0
Horned grebe	0	0	0	0	0	2	0	0	0	0
Red-necked grebe	0	0	0	0	0	0	0	0	0	0
***Podiceps* sp.**	0	0	0	0	0	0	0	0	0	0
Northern/yellow-shafted flicker	0	4	0	0	0	0	0	0	0	0
cf. Northern/yellow-shafted flicker	0	0	0	0	1	0	0	0	0	0

APPENDIX A *continued*

Table IV continued

Bird	DA	IE	HA	SL	UB	RT	BA	CO	RA	CV
Passenger pigeon	0	8	0	4	4	8	5	12	0	0
Columbid	0	0	0	0	0	0	0	0	0	0
Wild turkey	0	2	4	0	0	1	0	0	0	12
Ruffed grouse	4	5	8	1	0	0	0	2	0	0
Spruce grouse	0	0	0	0	0	2	0	0	0	0
Grouse	0	0	0	0	0	0	0	0	0	0
Tetraonid	0	0	0	0	0	0	0	0	0	0
***Colinus* sp.**	0	0	0	0	0	0	0	0	1	0
Phasianid	0	0	0	0	0	0	0	0	0	0
Tundra/Whistling swan	0	0	0	0	0	0	0	0	2	0
Canada goose	4	0	0	1	4	2	0	2	0	0
Goose	0	0	0	0	7	0	0	0	0	0
Wood duck	0	6	0	0	0	0	0	0	0	0
Northern shoveler	0	0	0	0	0	0	0	0	0	0
Blue-winged teal	0	1	0	0	0	1	0	0	9	0
Teal	0	0	0	0	0	0	0	0	0	0
Mallard	0	0	0	0	0	0	0	0	2	0
American black duck	0	1	0	0	0	0	0	0	0	0
***Anas* sp.**	0	0	0	0	0	0	0	0	0	0
Ring-necked duck	0	2	0	0	0	0	0	0	0	0
Aythinae	0	0	0	0	0	0	0	0	0	0
Bufflehead	0	0	0	0	0	0	0	0	0	0
Common goldeneye	0	0	0	0	0	0	0	0	0	0
***Bucephala* sp.**	0	0	0	0	0	0	0	0	0	0
Old squaw	0	0	0	0	0	0	0	0	0	0
Hooded merganser	0	0	0	0	0	0	0	0	0	0
White-winged scoter	0	0	0	0	0	0	0	0	0	0
Surf scoter	0	0	0	0	0	0	0	0	0	0
***Melanitta* sp.**	0	0	0	0	0	0	0	0	0	0
Common merganser	0	13	0	0	0	0	0	0	3	0
Red-breasted merganser	0	0	0	0	0	0	0	0	0	0
***Mergus* sp.**	0	0	0	0	0	0	0	0	0	0
Small duck	0	0	0	0	0	0	0	0	0	0
Medium duck	0	0	0	0	0	0	0	0	0	0
Large duck	0	0	0	0	0	0	0	0	0	0
Duck	2	0	0	0	18	0	0	0	0	0
Anserinae	0	0	0	0	0	0	0	0	4	1
Anatid	0	0	0	0	0	0	0	0	0	0
Common loon	0	0	0	0	0	0	0	0	0	0
Red-throated loon	0	0	0	0	0	0	0	0	0	0
Horned grebe	0	0	0	0	0	0	0	0	0	0
Red-necked grebe	0	0	0	0	0	0	0	0	0	0
***Podiceps* sp.**	0	0	0	0	1	0	0	0	0	0
Northern/yellow-shafted flicker	0	0	0	0	0	0	0	0	0	0
cf. Northern/yellow-shafted flicker	0	0	0	0	0	0	0	0	0	0

APPENDIX A *continued*

Table IV continued

Bird	CB	SF	PO	VN	KE	BO	DW	YA	CA	BK
Red-headed woodpecker	0	0	0	0	0	0	0	0	0	0
Yellow-bellied sapsucker	0	0	0	0	0	0	0	0	1	0
Piciformes	0	0	0	0	0	0	0	0	0	0
Northern saw-whet owl	0	0	0	0	0	0	0	0	0	0
Great horned owl	0	0	0	0	0	0	0	0	0	0
Snowy owl	0	0	0	0	0	0	0	0	0	0
Barred owl	0	0	2	3	0	0	0	0	1	0
Strigid	0	0	0	0	0	0	0	0	0	0
Northern goshawk	0	0	0	0	0	0	0	0	0	0
Sharp-shinned hawk	0	0	0	0	0	0	0	0	0	0
Golden eagle	0	0	0	0	0	0	0	0	0	0
Eagle	0	0	0	0	0	0	0	0	0	0
Red-tailed hawk	0	0	0	0	0	0	0	0	0	0
Red-shouldered hawk	0	0	0	5	0	0	0	0	0	0
Buteoninae	0	0	0	0	0	1	0	0	0	0
Marsh hawk/Northern harrier	0	0	0	0	0	0	0	0	0	0
Accipitrid	0	0	0	0	0	0	0	0	2	0
Hawk or Owl	0	0	0	0	0	0	0	0	0	0
Great blue heron	0	0	0	0	0	0	0	0	0	0
American coot	0	0	0	0	0	0	0	0	0	0
Sandhill crane	0	0	0	1	0	0	0	0	0	0
Heron or Crane	0	0	0	0	0	0	0	0	0	0
Alcid	0	0	1	0	0	0	0	0	0	0
Greater yellowlegs	0	0	0	0	0	0	0	0	0	0
Belted kingfisher	0	0	0	0	0	0	0	0	0	0
Carolina parakeet	0	0	0	0	0	0	0	0	3	0
Common raven	0	0	0	0	0	3	0	0	0	0
Common crow	0	0	0	0	0	0	0	0	0	0
Blue jay	0	0	0	0	0	0	0	0	0	0
cf. Blue jay	0	0	0	0	0	0	0	0	0	0
Bobolink	0	0	0	0	0	0	0	0	0	0
Indigo bunting	0	0	0	0	0	0	0	0	5	0
***Seiurus* sp.**	0	0	0	0	0	0	0	0	0	0
Passeriformes	0	0	0	1	0	0	0	0	0	0
Small bird	0	0	0	0	0	0	0	0	0	0
Small to medium bird	0	0	0	0	2	0	0	0	0	0
Medium bird	0	0	0	0	0	0	0	0	0	0
Medium to large bird	0	0	0	0	0	0	0	0	0	0
Large bird	0	0	0	0	0	0	0	0	0	0
Bird	5	0	43	51	18	2	406	0	79	0
Total	**5**	**0**	**66**	**121**	**23**	**23**	**406**	**4**	**182**	**0**

APPENDIX A *continued*

Table IV continued

Bird	LT	RO	UR	GU	BE	MR	SC	HR	UN	CY
Red-headed woodpecker	0	0	0	0	0	0	0	0	0	0
Yellow-bellied sapsucker	0	0	0	0	0	0	0	0	0	0
Piciformes	0	0	0	0	0	0	0	0	0	0
Northern saw-whet owl	0	0	0	0	0	0	0	0	0	2
Great horned owl	0	0	0	0	0	5	0	0	0	0
Snowy owl	0	0	0	0	0	0	0	0	0	0
Barred owl	0	0	0	1	0	0	0	0	1	2
Strigid	0	0	0	0	0	0	0	1	0	0
Northern goshawk	0	0	0	0	0	0	0	0	0	0
Sharp-shinned hawk	0	0	0	0	2	0	1	0	0	0
Golden eagle	0	0	0	0	0	0	0	0	0	0
Eagle	0	0	0	0	0	0	0	0	0	0
Red-tailed hawk	0	0	0	1	0	0	0	0	0	0
Red-shouldered hawk	0	0	0	0	0	0	0	0	0	0
Buteoninae	0	0	0	0	0	0	0	0	0	0
Marsh hawk/Northern harrier	0	0	0	0	0	0	0	0	0	0
Accipitrid	0	0	0	0	0	0	1	1	0	0
Hawk or Owl	0	0	0	1	0	0	0	0	0	0
Great blue heron	0	0	0	0	0	0	0	0	0	0
American coot	0	0	0	0	0	0	0	0	0	0
Sandhill crane	0	0	0	1	2	7	0	0	0	0
Heron or Crane	0	0	0	4	0	0	0	0	0	0
Alcid	0	0	0	0	0	0	0	0	0	0
Greater yellowlegs	0	0	0	0	0	0	0	0	0	0
Belted kingfisher	0	0	0	0	0	0	0	0	0	0
Carolina parakeet	0	0	0	0	0	0	0	0	0	0
Common raven	0	0	0	6	0	0	0	0	0	0
Common crow	0	0	0	0	1	0	0	0	0	0
Blue jay	0	0	0	1	0	0	0	0	0	0
cf. Blue jay	0	0	0	0	0	0	0	0	0	0
Bobolink	0	0	0	0	0	0	0	0	0	1
Indigo bunting	0	0	0	0	0	0	0	0	0	0
***Seiurus* sp.**	0	0	0	0	0	2	0	0	0	0
Passeriformes	0	0	0	0	0	0	0	0	0	0
Small bird	0	0	0	31	0	0	0	0	0	0
Small to medium bird	0	0	0	0	0	0	0	0	0	0
Medium bird	0	0	0	876	0	0	0	0	0	0
Medium to large bird	0	0	0	0	0	0	0	0	0	0
Large bird	0	0	0	42	0	0	0	0	0	0
Bird	0	8	217	0	0	69	0	0	0	0
Total	**13**	**8**	**217**	**1114**	**40**	**141**	**19**	**6**	**19**	**148**

APPENDIX A *continued*

Table IV continued

Bird	RF	WB	IT	VE	AC	CR	PI	FN	SK	NO
Red-headed woodpecker	0	1	0	0	0	0	0	0	0	0
Yellow-bellied sapsucker	0	0	0	0	0	0	0	1	0	0
Piciformes	0	0	0	0	0	0	0	0	0	1
Northern saw-whet owl	0	0	0	0	0	0	0	0	0	0
Great horned owl	0	0	0	0	0	0	0	0	0	0
Snowy owl	2	0	0	0	0	1	0	0	0	0
Barred owl	0	2	0	0	0	0	0	0	0	0
Strigid	0	0	0	0	0	0	0	0	0	0
Northern goshawk	1	0	0	0	0	0	0	0	0	0
Sharp-shinned hawk	0	0	0	0	0	0	0	0	0	0
Golden eagle	0	0	0	0	0	0	0	0	0	0
Eagle	0	0	0	0	0	0	0	0	0	0
Red-tailed hawk	0	0	0	0	0	0	0	0	0	0
Red-shouldered hawk	0	0	0	0	0	0	0	0	0	0
Buteoninae	0	0	0	0	0	0	0	0	0	0
Marsh hawk/Northern harrier	0	0	0	0	0	0	2	0	0	0
Accipitrid	0	0	0	0	0	0	1	0	0	0
Hawk or Owl	0	0	0	0	0	0	0	0	0	0
Great blue heron	0	1	0	0	0	0	0	0	0	0
American coot	0	0	0	0	4	0	0	0	0	0
Sandhill crane	0	16	0	0	0	1	0	0	0	0
Heron or Crane	0	0	0	0	0	0	0	0	0	0
Alcid	0	0	0	0	0	0	0	0	0	0
Greater yellowlegs	2	0	0	0	0	0	0	0	0	0
Belted kingfisher	0	0	0	0	0	0	0	0	0	0
Carolina parakeet	0	0	0	0	0	0	0	0	0	0
Common raven	1	3	0	0	0	0	0	0	0	0
Common crow	0	0	0	0	1	0	0	0	0	0
Blue jay	0	0	0	0	0	0	0	0	0	0
cf. Blue jay	0	0	0	0	0	0	0	0	1	0
Bobolink	0	0	0	0	0	0	0	0	0	0
Indigo bunting	0	0	0	0	0	0	0	0	0	0
***Seiurus* sp.**	0	0	0	0	0	0	0	0	0	0
Passeriformes	0	0	0	0	0	0	0	0	0	0
Small bird	0	0	0	0	0	0	0	0	0	0
Small to medium bird	0	0	0	0	0	0	0	0	0	0
Medium bird	0	0	0	0	0	0	0	0	0	0
Medium to large bird	0	0	0	0	0	0	0	1	0	0
Large bird	0	0	0	0	0	0	0	0	0	0
Bird	0	0	0	0	0	0	28	0	15	0
Total	**16**	**433**	**11**	**3**	**15**	**52**	**50**	**48**	**24**	**3**

APPENDIX A *continued*

Table IV continued

Bird	DA	IE	HA	SL	UB	RT	BA	CO	RA	CV
Red-headed woodpecker	0	0	0	0	0	0	0	0	0	0
Yellow-bellied sapsucker	0	0	0	0	0	0	0	0	0	0
Piciformes	0	0	0	0	0	0	0	0	0	0
Northern saw-whet owl	0	0	0	0	0	0	0	0	0	0
Great horned owl	0	0	0	0	0	0	0	0	0	0
Snowy owl	0	0	0	0	0	0	0	0	0	0
Barred owl	0	0	0	0	0	0	0	1	0	0
Strigid	0	0	1	0	0	0	0	0	1	1
Northern goshawk	0	0	0	0	0	0	0	0	0	0
Sharp-shinned hawk	0	0	0	0	0	0	0	0	0	0
Golden eagle	0	0	0	0	0	0	0	0	0	1
Eagle	0	0	0	0	0	0	0	0	0	1
Red-tailed hawk	0	0	1	0	0	0	0	0	0	0
Red-shouldered hawk	0	0	0	0	0	0	0	0	0	0
Buteoninae	0	0	0	0	0	0	0	0	0	0
Marsh hawk/Northern harrier	0	0	0	0	0	0	0	0	0	0
Accipitrid	0	0	0	0	0	2	0	0	0	0
Hawk or Owl	0	0	0	0	0	0	0	0	0	0
Great blue heron	0	0	0	0	0	0	0	0	0	0
American coot	0	0	0	0	0	0	0	0	0	0
Sandhill crane	0	0	0	0	0	0	0	2	0	3
Heron or Crane	0	0	0	0	0	0	0	0	0	0
Alcid	0	0	0	0	0	0	0	0	0	0
Greater yellowlegs	0	0	0	0	0	0	0	0	0	0
Belted kingfisher	0	0	0	0	0	0	0	0	0	1
Carolina parakeet	0	0	0	0	0	0	0	0	0	0
Common raven	0	0	0	0	0	0	0	0	0	0
Common crow	0	0	0	0	0	0	0	0	0	1
Blue jay	0	0	0	0	0	0	0	0	0	0
cf. Blue jay	0	0	1	0	0	0	0	0	0	0
Bobolink	0	0	0	0	0	0	0	0	0	0
Indigo bunting	0	0	0	0	0	0	0	0	0	0
***Seiurus* sp.**	0	0	0	0	0	0	0	0	0	0
Passeriformes	1	0	0	0	6	0	5	0	0	0
Small bird	0	0	0	0	0	0	0	0	0	0
Small to medium bird	0	0	0	0	0	0	0	0	0	0
Medium bird	0	0	0	0	0	0	0	0	0	0
Medium to large bird	0	0	0	0	0	0	0	0	0	0
Large bird	0	0	0	0	0	0	0	0	0	0
Bird	5	0	20	18	82	0	4	0	0	9
Total	**16**	**38**	**35**	**24**	**122**	**16**	**14**	**19**	**22**	**30**

APPENDIX A *continued*

Table V. Reptiles

Western Basin

Reptile	SI	VB	MO	IA	DY	RR	CL	BC	LS	SH	LI	LB	DB
Common snapping turtle	0	0	0	0	0	1	0	0	0	0	0	6	0
Painted turtle	0	3	0	0	5	0	0	0	1	0	0	9	0
Blanding's turtle	0	0	0	0	2	0	0	0	0	0	0	2	0
Common musk turtle	0	0	0	0	3	0	0	0	0	0	0	0	0
Emydid	0	2	0	0	13	7	0	0	0	1	0	17	0
Testudines	0	0	4	0	5	5	0	0	0	0	57	8	29
Eastern fox snake	0	0	0	0	0	0	0	0	0	0	0	8	0
***Thamnophis* sp.**	0	0	0	0	0	0	0	0	0	0	0	14	0
Squamata	0	0	0	0	0	0	0	0	0	0	2	1	6
Reptile	0	0	0	0	0	0	0	0	21	0	0	0	0
Total	**0**	**5**	**4**	**0**	**28**	**13**	**0**	**0**	**22**	**1**	**59**	**65**	**35**

Table V continued

Iroquoian

Reptile	CB	SF	PO	VN	KE	BO	DW	YA	CA	BK	LT	RO	UR	GU	BE	MR	SC	HR	UN	CY
***Chelonia* sp.**	0	0	0	0	0	0	0	0	0	0	0	0	0	56	0	1	0	0	0	14
Common snapping turtle	1	0	0	18	0	0	0	0	27	0	0	0	0	0	7	12	0	0	0	6
cf. Common snapping turtle	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spotted turtle	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0
Wood turtle	0	0	36	0	0	0	0	0	0	0	0	0	0	0	3	0	7	8	0	1
Painted turtle	0	0	0	44	0	1	0	0	17	0	0	0	0	0	23	73	2	0	12	24
Blanding's turtle	0	0	1	8	0	0	0	0	2	0	0	0	0	0	0	4	1	0	4	0
Common map turtle	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Common musk turtle	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Eastern spiny softshell turtle	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
***Pseudemys* sp.**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Emydinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
Emydid	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Small turtle	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Small to medium turtle	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Testudines	0	0	16	6	2	0	0	0	23	16	0	0	0	0	0	0	0	0	0	0
Eastern fox snake	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
***Thamnophis* sp.**	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Timber rattlesnake	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Viperid	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Colubrid	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Reptile	0	0	0	0	0	0	23	0	0	0	0	0	28	0	0	74	0	0	0	0
Total	**1**	**2**	**54**	**76**	**4**	**2**	**23**	**0**	**71**	**16**	**0**	**0**	**28**	**56**	**33**	**165**	**10**	**8**	**18**	**53**

APPENDIX A *continued*

Table V continued

Reptile	RF	WB	IT	VE	AC	CR	PI	FN	SK	NO	DA	IE	HA	SL	UB	RT	BA	CO	RA	CV
***Chelonia* sp.**	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1
Common snapping turtle	0	0	0	0	0	1	1	0	0	0	1	0	0	2	92	1	0	3	0	19
cf. Common snapping turtle	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Spotted turtle	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Wood turtle	0	2	0	0	6	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0
Painted turtle	0	34	2	2	2	6	0	0	0	1	0	3	9	0	416	4	0	1	0	12
Blanding's turtle	0	0	0	0	0	0	0	0	0	0	0	2	0	0	9	0	0	0	0	2
Common map turtle	0	3	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	2
Common musk turtle	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastern spiny softshell turtle	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
***Pseudemys* sp.**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
Emydinae	0	2	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Emydid	0	0	0	0	0	0	0	0	0	0	0	0	4	0	174	0	0	0	0	7
Small turtle	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Small to medium turtle	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Testudines	0	0	0	0	0	0	3	0	2	0	0	0	0	0	1753	0	0	0	0	0
Eastern fox snake	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0
***Thamnophis* sp.**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	87	0	135	48	0	0
Timber rattlesnake	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Viperid	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Colubrid	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Reptile	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
Total	**6**	**54**	**2**	**2**	**17**	**14**	**4**	**0**	**3**	**1**	**1**	**6**	**15**	**2**	**2540**	**12**	**137**	**52**	**3**	**43**

APPENDIX A *continued*

Table VI. Amphibians

Western Basin

Amphibian	SI	VB	MO	IA	DY	RR	CL	BC	LS	SH	LI	LB	DB
Eastern American toad	0	0	0	0	0	0	0	0	0	0	0	0	0
Bufonid	0	0	0	0	0	4	0	0	0	0	0	0	0
Ranid	0	0	0	0	13	0	0	0	0	0	0	8	0
Anura	0	0	0	0	0	2	1	15	0	0	0	11	2
Total	**0**	**0**	**0**	**0**	**13**	**6**	**1**	**15**	**0**	**0**	**0**	**19**	**2**

APPENDIX A *continued*

Table VI continued

Iroquoian

Amphibian	CB	SF	PO	VN	KE	BO	DW	YA	CA	BK	LT	RO	UR	GU	BE	MR	SC	HR	UN	CY
Eastern American toad	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bufo sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0
Bullfrog	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	10	0	1	0	0
Rana sp.	0	0	63	7	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
Anura	0	0	0	0	0	0	0	0	0	0	0	0	0	48	182	79	0	1	0	49
Ambystoma sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mudpuppy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amphibian	0	0	0	0	0	0	91	0	0	0	0	0	22	0	0	0	0	0	0	0
Total	**0**	**0**	**63**	**7**	**0**	**0**	**91**	**0**	**0**	**0**	**0**	**0**	**22**	**55**	**182**	**98**	**0**	**2**	**0**	**49**

Amphibian	RF	WB	IT	VE	AC	CR	PI	FN	SK	NO	DA	IE	HA	SL	UB	RT	BA	CO	RA	CV
Eastern American toad	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	4	0	0	0
Bufo sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1
Bullfrog	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Rana sp.	0	0	0	0	0	0	0	0	0	0	2	0	0	3	0	0	6	116	0	0
Anura	0	6	0	0	0	195	0	7	8	0	34	0	26	0	0	0	25	52	0	20
Ambystoma sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Mudpuppy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0
Amphibian	0	0	0	0	0	0	0	0	0	0	0	0	90	0	15	0	0	0	0	0
Total	**0**	**6**	**0**	**0**	**0**	**195**	**0**	**7**	**8**	**0**	**37**	**0**	**116**	**3**	**15**	**4**	**35**	**193**	**0**	**21**

APPENDIX A *continued*

Table VII. Mussels

Western Basin

Mussel	SI	VB	MO	IA	DY	RR	CL	BC	LS	SH	LI	LB	DB
***Sphaerium* sp.**	0	0	0	0	0	0	0	0	0	0	0	1	0
Threeridge	0	0	0	0	0	0	0	0	0	0	0	1	0
Eastern elliptio	0	0	0	0	0	0	0	1	0	0	0	0	0
Lady finger/spike	0	0	0	0	0	0	0	1	0	0	0	0	0
***Elliptio* sp.**	0	1	0	0	5	1	0	0	0	0	0	0	0
Fat mucket/eastern lamp	0	0	0	0	0	1	0	1	0	0	0	3	0
Pocket-book	0	0	0	0	6	0	0	0	0	0	0	1	0
Pink heelsplitter	0	1	0	0	0	0	0	0	0	0	0	0	0
Unionid	0	10	0	0	46	5	7	0	0	5	0	67	0
Mussel	0	0	3	2	0	0	0	21	0	0	186	0	78
Total	**0**	**12**	**3**	**2**	**57**	**7**	**7**	**24**	**0**	**5**	**186**	**73**	**78**

APPENDIX A *continued*

Table VII continued

Iroquoian

Mussel	CB	SF	PO	VN	KE	BO	DW	YA	CA	BK	LT	RO	UR	GU	BE	MR	SC	HR	UN	CY
***Sphaerium* sp.**	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spheriid	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Actinonaias carinata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Floater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
***Anodonta* sp.**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastern elliptio	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	1	0
Lady finger/spike	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	1
***Elliptio* sp.**	0	0	Y	0	0	0	0	0	1	0	0	0	0	46	1	0	0	0	0	2
Fluted shell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fat mucket/eastern lamp	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Pocket-book	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
***Lampsilis* sp.**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Fragile papershell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Black sand-shell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
***Ligumia* sp.**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Olive hickory-nut	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pink heelsplitter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Squaw foot	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unionid	0	1	0	0	0	6	0	0	14	0	0	0	0	0	0	4	0	0	2	66
Mussel	Y	0	0	22	0	0	0	0	0	0	0	0	0	0	0	36	0	0	0	0
Total	**Y**	**1**	**Y**	**22**	**0**	**7**	**0**	**0**	**19**	**0**	**0**	**0**	**0**	**46**	**1**	**44**	**1**	**0**	**3**	**70**

Note: Y indicates that mussels are present but not quantified in the assemblage.

APPENDIX A *continued*

Table VII continued

Mussel	RF	WB	IT	VE	AC	CR	PI	FN	SK	NO	DA	IE	HA	SL	UB	RT	BA	CO	RA	CV
***Sphaerium* sp.**	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spheriid	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Actinonaias carinata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Floater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
***Anodonta* sp.**	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastern elliptio	0	10	0	3	5	0	0	1	0	0	0	2	0	0	0	4	0	0	0	34
Lady finger/spike	0	1	1	0	0	0	0	1	0	0	0	3	10	0	0	0	3	0	0	50
***Elliptio* sp.**	0	3	2	0	4	0	0	0	1	1	2	0	0	2	0	12	0	0	0	19
Fluted shell	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Fat mucket/eastern lamp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Pocket-book	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19
***Lampsilis* sp.**	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Fragile papershell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Black sand-shell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28
***Ligumia* sp.**	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Olive hickory-nut	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Pink heelsplitter	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Squaw foot	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Unionid	0	0	5	0	41	4	0	4	0	0	12	0	0	6	7	47	12	0	0	90
Mussel	0	0	0	0	0	0	10	0	85	0	0	0	98	0	0	0	6	0	0	0
Total	**0**	**16**	**10**	**5**	**50**	**5**	**10**	**6**	**86**	**5**	**14**	**5**	**108**	**8**	**7**	**64**	**21**	**0**	**0**	**251**

APPENDIX A *continued*

Table VIII. Snails

Western Basin

Snail	SI	VB	MO	IA	DY	RR	CL	BC	LS	SH	LI	LB	DB
Flamed disc/tigersnail	0	0	0	0	0	0	0	5	0	0	0	0	0
White-lip	0	0	0	0	0	0	0	2	0	0	0	0	0
Northern three-tooth	0	0	0	0	0	0	0	2	0	0	0	0	0
***Triodopsis* sp.**	0	0	0	0	0	0	0	1	0	0	0	0	0
***Mesomphix* sp.**	0	0	0	0	0	0	0	3	0	0	0	0	0
Snail	0	0	1	0	0	0	0	31	4	0	500	0	249
Total	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**44**	**4**	**0**	**500**	**0**	**249**

Table VIII continued

Iroquoian

Snail	CB	SF	PO	VN	KE	BO	DW	YA	CA	BK	LT	RO	UR	GU	BE	MR	SC	HR	UN	CY
Flamed disc/tigersnail	0	0	0	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rotund disc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Black gloss	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Atlantic marginella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Whelk or Conch	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
***Prunum* sp.**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ramshorn	0	0	0	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sharp hornsnail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Great Lakes hornsnail	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-lip globe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upland pillsnail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lowland pillsnail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-lip	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polygyrid	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pointed campeloma	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Copper button	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zonitid	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Snail	0	8	0	0	0	1	0	0	1	0	0	0	0	9	0	0	0	0	0	0
Total	**0**	**8**	**1**	**51**	**0**	**2**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**9**	**0**	**0**	**0**	**0**	**0**	**0**

Table VIII continued

Snail	RF	WB	IT	VE	AC	CR	PI	FN	SK	NO	DA	IE	HA	SL	UB	RT	BA	CO	RA	CV
Flamed disc/tigersnail	0	0	0	0	0	0	0	0	38	0	0	0	0	0	0	0	0	0	0	765
Rotund disc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Black gloss	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Common Atlantic marginella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
Whelk or Conch	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
***Prunum* sp.**	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Ramshorn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sharp hornsnail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	14
Great Lakes hornsnail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
White-lip globe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19
Upland pillsnail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Lowland pillsnail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
White-lip	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	61
Polygyrid	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Pointed campeloma	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
Copper button	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	79
Zonitid	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Snail	0	0	0	0	0	0	5	0	109	0	0	0	149	0	0	0	0	0	0	13
Total	**0**	**0**	**0**	**0**	**0**	**0**	**5**	**0**	**149**	**0**	**0**	**0**	**150**	**0**	**5**	**0**	**0**	**0**	**0**	**987**

APPENDIX B: Faunal Phyla, Subphyla, Classes, Families, Subfamilies, Genera, and Species Identified in the Southern Ontario Zooarchaeological Record

Phylum Chordata

Subphylum Vertebrata

Class Mammalia (Mammals)

Order Artiodactyla (Even-toed Ungulates)

Family Cervidae (Deer)

Moose	*Alces alces*
Elk	*Cervus elaphus/canadensis*
White-tailed deer	*Odocoileus virginianus*
Caribou	*Rangifer tarandus*

Order Lagomorpha (Pikas, Rabbits, and Hares)

Family Leporidae (Rabbits and Hares)

Snowshoe hare	*Lepus americanus*
Eastern cottontail	*Sylvilagus floridanus*

Order Rodentia (Rodents)

Family Castoridae (Beavers)

American beaver	*Castor canadensis*

Family Sciuridae (Squirrels)

Northern flying squirrel	*Glaucomys sabrinus*
Southern flying squirrel	*Glaucomys volans*
Woodchuck/groundhog	*Marmota monax*
Eastern gray squirrel	*Sciurus carolinensis*
Eastern fox squirrel	*Sciurus niger*
Eastern chipmunk	*Tamias striatus*
Red squirrel	*Tamiasciurus hudsonicus*

Family Muridae (Rats and Mice)

White-footed mouse	*Peromyscus leucopus*
Deer mouse	*Peromyscus maniculatus*

Family Arvicolinae (Voles, Muskrats, and Lemmings)

Southern red-backed vole	*Clethrionomys gapperi*
Rock vole	*Microtus chrotorrhinus*
Meadow vole	*Microtus pennsylvanicus*
Woodland vole	*Microtus pinetorum*
Eastern heather vole	*Phenacomys ungava*
Common muskrat	*Ondatra zibithecus*
Southern bog lemming	*Synaptomys cooperi*

APPENDIX B *continued*

Family Murinae (Introduced Rats and Mice)	
House mouse	*Mus musculus*
Norway rat	*Rattus norvegicus*
Family Dipodidae (Jumping Mice)	
Woodland jumping mouse	*Napaeozapus insignis*
Meadow Jumping mouse	*Zapus hudsonicus*
Family Erethrizontidae (New World Porcupines)	
North American porcupine	*Erethizon dorsatum*
Order Soricimorpha (Shrews and Moles)	
Family Soricidae (Shrews)	
Northern short-tailed shrew	*Blarina brevicauda*
Least shrew	*Cryptotis parva*
Masked shrew	*Sorex cinereus*
Smoky shrew	*Sorex fumeus*
Pygmy shrew	*Sorex hoyi*
American water shrew	*Sorex palustris*
Family Talpidae (Moles)	
Star-nosed mole	*Condylura cristata*
Hairy-tailed mole	*Parascalops breweri*
Eastern mole	*Scalopus aquaticus*
Order Didelphimorphia (New World Opossums)	
Family Didelphidae	
Virginia opossum	*Didelphis virginiana*
Order Carnivora (Carnivores)	
Family Canidae (Wolves and Foxes)	
Domestic dog	*Canis familiaris*
Coyote	*Canis latrans*
Gray wolf	*Canis lupus*
Common gray fox	*Urocyon cinereoargenteus*
Red fox	*Vulpes vulpes*
Family Ursidae (Bears)	
Black bear	*Ursus americanus*
Family Procyonidae (Raccoons and Relatives)	
Northern raccoon	*Procyon lotor*
Family Mephitidae (Skunks)	
Striped skunk	*Mephitis mephitis*

Appendix B *continued*

Family Mustelidae (Weasels, Otters, and Relatives)	
Wolverine	*Gulo gulo*
Northern river otter	*Lontra canadensis*
American marten	*Martes americana*
Fisher	*Martes pennanti*
Ermine	*Mustela erminea*
Long-tailed weasel	*Mustela frenata*
Least weasel	*Mustela nivalis*
American mink	*Mustela vison*
American badger	*Taxidea taxus*
Family Felidae (Cats)	
Canadian lynx	*Lynx canadensis*
Bobcat	*Lynx rufus*
Class Osteichthyes (Fishes)	
Order Perciformes (Perch-like Fishes)	
Family Centrarchidae (Sunfishes)	
Rock bass	*Ambloplites rupestris*
Pumpkinseed	*Lepomis gibbosus*
Bluegill	*Lepomis macrochirus*
Green sunfish	*Lepomis cyanellus*
Smallmouth bass	*Micropterus dolomieui*
Largemouth bass	*Micropterus salmoides*
White crappie	*Pomoxis annularis*
Black crappie	*Pomoxis nigromaculatus*
Family Percichthyidae (Temperate Basses)	
White bass	*Morone crysops*
Family Sciaenidae (Drums and Croakers)	
Freshwater drum	*Aplodinotus grunniens*
Family Percidae (Perches)	
Yellow perch	*Perca flavescens*
Sauger	*Sander canadense*
Walleye	*Sander vitreum*

APPENDIX B *continued*

Order Cypriniformes (Carps, Minnows, and Suckers)	
Family Catostomidae (Suckers)	
Quillback	*Carpiodes cyprinus*
Longnose sucker	*Catostomus catostomus*
White sucker	*Catostomus commersoni*
Bigmouth buffalo	*Ictiobus cyprinellus*
Silver redhorse	*Moxostoma anisurum*
Golden redhorse	*Moxostoma erythrurum*
Greater redhorse	*Moxostoma valenciennesi*
Family Cyprinidae (Minnows and Carps)	
Northern redbelly dace	*Chrosomus eos*
Finescale dace	*Chrosomus neogaeus*
Creek chub	*Semotilus atromaculatus*
Fallfish	*Semotilus corporalis*
Pearl dace	*Semotilus margarita*
Order Amiiformes (Bowfins)	
Family Amiidae (Bowfins)	
Bowfin	*Amia calva*
Order Acipenseriformes (Sturgeons and Paddlefishes)	
Family Acipenseridae (Sturgeons)	
Lake sturgeon	*Acipenser fulvescens*
Order Esociformes (Pikes and Relatives)	
Family Esocidae (Pikes)	
Grass pickerel	*Esox americanus*
Northern pike	*Esox lucius*
Muskellunge	*Esox masquinongy*
Order Siluriformes (Catfishes)	
Family Ictaluridae (Catfishes)	
Black bullhead	*Ictalurus melas*
Yellow bullhead	*Ictalurus natalis*
Brown bullhead	*Ictalurus nebulosus*
Channel catfish	*Ictalurus punctatus*
Stonecat	*Noturus flavus*
Tadpole madtom	*Noturus gyrinus*
Brindled madtom	*Noturus miurus*
Order Lepisosteiformes (Gars)	
Family Lepisosteidae (Gars)	
Spotted gar	*Lepisosteus oculatus*
Longnose gar	*Lepisosteus osseus*

APPENDIX B *continued*

Order Salmoniformes (Salmon-like Fishes)	
Family Salmonidae (Salmons)	
Subfamily Salmoninae (Salmons, Trouts, and Chars)	
Atlantic salmon	*Salmo salar*
Rainbow trout	*Salmo gairdneri*
Brook trout	*Salvelinus fontinalis*
Lake trout	*Salvelinus namaycush*
Subfamily Coregoninae (Whitefishes)	
Longjaw cisco	*Coregonus alpenae*
Cisco/lake herring	*Coregonus artedii*
Bloater	*Coregonus hoyi*
Deepwater cisco	*Coregonus johannae*
Kiyi	*Coregonus kiyi*
Blackfin cisco	*Coregonus nigripinnis*
Shortnose cisco	*Coregonus reighardi*
Shortjaw cisco	*Coregonus zenithicus*
Lake whitefish	*Coregonus clupeaformis*
Round whitefish	*Prosopium cylindraceum*
Order Gadiformes (Cod-like Fishes)	
Family Gadidae (Cods)	
Burbot	*Lota lota*
Order Anguilliformes (Eels)	
Family Anguillidae (Freshwater Eels)	
American eel	*Anguilla rostrata*
Order Hiodontiformes (Mooneyes)	
Family Hiodontidae (Mooneyes)	
Mooneye	*Hiodon tergisus*
Order Clupeiformes (Herring-like Fishes)	
Family Clupeidae (Herrings)	
Alewife	*Alosa pseudoharengus*
Gizzard shad	*Dorosoma cepedianum*

APPENDIX B *continued*

Class Aves (Birds)

Order Columbiformes

Family Columbidae (Pigeons and Doves)

Passenger pigeon	*Ectopistes migratorius*
Mourning dove	*Zenaidura macroura*

Order Galliformes (Chicken-like Birds)

Subfamily Meleagridinae (Turkeys)

Wild turkey	*Meleagris gallopavo*

Family Phasianidae (Turkeys, Grouse, Quail, Partridges, and Pheasants)

Subfamily Tetraoninae (Grouse)

Ruffed grouse	*Bonasa umbellus*
Spruce grouse	*Dendragapus canadensis*

Subfamily Phasianinae (Quail, Partridges, and Pheasants)

Northern bobwhite	*Colinus virginianus*
Ring-necked pheasant	*Phasianus colchicus*

Order Anseriformes (Swans, Geese, and Ducks)

Family Anatidae (Swans, Geese, and Ducks)

Subfamily Anserinae (Swans, Geese, and Ducks)

Tundra/whistling swan	*Cygnus columbianus*
Trumpeter swan	*Cygnus buccinator*
Canada goose	*Branta canadensis*
Snow goose	*Chen caerulescens*
Ross' goose	*Chen rossii*
Wood duck	*Aix sponsa*
Northern pintail	*Anas acuta*
American wigeon	*Anas americana*
Northern shoveler	*Anas clypeata*
Green-winged teal	*Anas crecca*
Blue-winged teal	*Anas discors*
Mallard	*Anas platyrynchos*
American black duck	*Anas rubripes*
Lesser scaup	*Aythya affinis*
Redhead	*Aythya americana*
Ring-necked duck	*Aythya collaris*
Greater scaup	*Aythya marila*
Canvasback	*Aythya valisineria*
Bufflehead	*Bucephala albeola*
Common goldeneye	*Bucephala clangula*
Oldsquaw	*Clangula hyemalis*

APPENDIX B *continued*

Hooded merganser	*Lophodytes cucullatus*
White-winged scoter	*Melanitta fusca*
Common/black scoter	*Melanitta nigra*
Surf scoter	*Melanitta perspicillata*
Common merganser	*Mergus merganser*
Red-breasted merganser	*Mergus serrator*
Ruddy duck	*Oxyura jamaicensis*
Common eider	*Somateria mollissima*
King eider	*Somateria spectabilis*
Order Gaviiformes	
Family Gaviidae (Loons)	
Common loon	*Gavia immer*
Red-throated loon	*Gavia stellata*
Order Podicipediformes	
Family Podicipedidae (Grebes)	
Horned grebe	*Podiceps auritus*
Red-necked grebe	*Podiceps grisegena*
Pied-billed grebe	*Podilymbus podiceps*
Order Pelecaniformes (Pelicans)	
Family Phalacrocoracidae (Cormorants and Ahingas)	
Double-crested cormorant	*Phalacrocorax auritas*
Order Piciformes	
Family Picidae (Woodpeckers)	
Northern/yellow-shafted flicker	*Colaptes auratus*
Hairy woodpecker	*Dendrocopos/Picoides villosus*
Downy woodpecker	*Dendrocopos/Picoides pubescens*
Pileated woodpecker	*Dryocopus pileatus*
Red-headed woodpecker	*Melanerpes erythrocephalus*
Yellow-bellied sapsucker	*Sphyrapicus varius*
Order Strigiformes	
Family Strigidae (Owls)	
Northern saw-whet owl	*Aegolius acadicus*
Short-eared owl	*Asio flammeus*
Long-eared owl	*Asio otus*
Great horned owl	*Bubo virginianus*
Snowy owl	*Nyctea scandiaca*
Eastern screech owl	*Otus asio*
Barred owl	*Strix varia*

APPENDIX B *continued*

Order Accipitriformes	
Family Accipitridae (Hawks and Eagles)	
Northern goshawk	*Accipiter gentilis*
Sharp-shinned hawk	*Accipiter striatus*
Golden eagle	*Aquila chrysaetos*
Red-tailed hawk	*Buteo jamaicensis*
Rough-legged hawk	*Buteo lagopus*
Red-shouldered hawk	*Buteo lineatus*
Marsh hawk/northern harrier	*Circus cyaneus*
Sparrow hawk	*Falco sparverius*
Bald eagle	*Haliaeetus leucocephalus*
Family Pandionidae (Ospreys)	
Osprey	*Pandion haliaetus*
Order Ciconiiformes	
Family Ardeidae (Herons)	
Great blue heron	*Ardea cinerea/herodias*
American bittern	*Botaurus lentiginosus*
Least bittern	*Ixobrychus exilis*
Black-crowned night heron	*Nycticorax nycticorax*
Order Gruiformes	
Family Gruidae (Cranes)	
American coot	*Fulica americana*
Sandhill crane	*Grus canadensis*
Order Charadriiformes (Shorebirds, Gulls, Auks, and Relatives)	
Family Alcidae (Auks and Relatives)	
Family Laridae (Gulls)	
Herring gull	*Larus argentatus*
Family Scolopacidae	
Greater yellowlegs	*Tringa melanoleuca*
Order Trogoniformes	
Family Trogonidae (Trogons)	
Belted kingfisher	*Ceryle alcyon*
Order Psittaciformes	
Family Psittacidae (Parrots)	
Carolina parakeet	*Conuropsis carolinensis*

APPENDIX B *continued*

Order Passeriformes

Family Corvidae (Crows and Ravens)

Common raven	*Corvus corax*
Common crow	*Corvus brachyrhynchos*
Blue jay	*Cyanocitta cristata*

Family Emberizidae (Grosbeaks, Sparrows, Buntings, Cardueline Finches, Blackbirds and Orioles)

Red-winged blackbird	*Agelaius phoeniceus*
Bobolink	*Dolichonyx oryzivorus*
Rusty blackbird	*Euphagus carolinus*
Brown-headed cowbird	*Molothrus ater*
Indigo bunting	*Passerina cyanea*
Common grackle	*Quiscalus quiscula*
Eastern meadowlark	*Sturnella magna*

Family Muscicapidae (Thrushes, Solitaires, and Bluebirds)

American robin	*Turdus migratorius*

Family Mimidae (Mockingbirds and Thrashers)

Gray catbird	*Dumetella carolinensis*
Brown thrasher	*Toxostoma rufum*

Family Parulidae (Warblers)

Northern waterthrush	*Parkesia*/*Seiurus noveboracensis*
Ovenbird	*Seiurus aurocapillus*

Family Tyrannidae (Tyrant Flycatchers)

Eastern kingbird	*Tyrannus tyrannus*

APPENDIX B *continued*

Class Reptilia (Reptiles)

Order Testudines

Family Cheloniidae (Sea Turtles)

Green turtle	*Chelonia mydas*

Family Chelydridae

Common snapping turtle	*Chelydra serpentine*

Family Emydidae (Pond and Box Turtles)

Spotted turtle	*Clemmys guttata*
Wood turtle	*Clemmys insculpta*
Painted turtle	*Chrysemys picta*
Blanding's turtle	*Emydoidea blandingii*
Common map turtle	*Graptemys geographica*
Eastern box turtle	*Terrapene carolina*
Eastern river cooter	*Pseudemys concinna*
Redbelly turtle	*Pseudemys rubriventris*

Family Kinosternidae (Musk and Mud Turtles)

Common musk turtle	*Sternotherus odoratus*

Family Trionychidae (Softshell Turtles)

Eastern spiny softshell turtle	*Apalone spinifera*

Order Squamata, Suborder Serpentes (Snakes)

Family Colubridae (Typical Snakes)

Racer	*Coluber constrictor*
Northern ring-necked snake	*Diadophis punctatus*
Eastern fox snake	*Elaphe gloydi*
Black rat snake	*Elaphe obsolete*
Eastern hog-nosed snake	*Heterodon platirhinos*
Eastern milk snake	*Lampropeltis triangulum*
Northern water snake	*Nerodia sipedon*
Smooth green snake	*Opheodrys vernalis*
Queen snake	*Regina septemvittata*
Brown snake	*Storeria dekayi*
Northern red-bellied snake	*Storeria occipitomaculata*
Butler’s garter snake	*Thamnophis butleri*
Northern ribbon snake	*Thamnophis sauritus*
Common garter snake	*Thamnophis sirtalis*

Family Viperidae (Pit Vipers and Vipers)

Timber rattlesnake	*Crotalus horridus*
Eastern massasauga	*Sistrurus catenatus*

APPENDIX B *continued*

Class Amphibia (Amphibians)

Order Anura

Family Bufonidae (Toads)

Eastern American toad	*Bufo americanus*
Fowler's toad	*Bufo fowleri*

Family Ranidae (True Frogs)

Bullfrog	*Rana catesbeiana*
Green frog	*Rana clamitans*
Pickerel frog	*Rana palustris*
Northern leopard frog	*Rana pipiens*
Wood frog	*Rana sylvatica*

Order Caudata (Salamanders)

Family Ambystomatidae (Mole Salamanders)

Blue-spotted salamander	*Ambystoma laterale*
Eastern tiger salamander	*Ambystoma tigrinium*
Jefferson salamander	*Ambystoma jeffersonianum*
Marbled salamander	*Ambystoma opacum*
Small-mouthed salamander	*Ambystoma texanum*
Spotted salamander	*Ambystoma maculatum*

Family Proteidae (Mudpuppies)

Mudpuppy	*Necturus maculosus*

APPENDIX B *continued*

Phylum Mollusca (Molluscs)

Class Bivalvia (Bivalves)

Family Sphaeriidae (Clams)

Fingernail clam	*Sphaerium simile*

Family Unionidae (Mussels)

	Actinonaias carinata
Threeridge	*Amblema plicata*
Cylindrical floater	*Anodontoides ferussacianus*
Floater	*Anodonta cataracta*
Eastern elliptio	*Elliptio complanata*
Lady finger/spike	*Elliptio dilatata*
Fluted shell	*Lasmigona costata*
Fat mucket / eastern lamp	*Lampsilis radiata*
Pocket-book	*Lampsilis ventricosa*
Fragile papershell	*Leptodea fragilis*
Black sand-shell	*Ligumia recta*
Olive hickory-nut	*Obovaria olivaria*
Pink heelsplitter	*Proptera alata/Potamilus alatus*
Squaw foot	*Strophinus undulatus*

Class Gastropoda (Snails)

Family Discidae

Flamed disc/tigersnail	*Anguispira alternata*
Forest disc	*Discus cronkhitei*
Rotund disc	*Discus rotundatus*

Family Gastrodontidae

Quick gloss	*Zonitoides arboreus*
Black gloss	*Zonitoides nitidus*

Family Helicodiscidae

Compound coil	*Helicodiscus parallelus*

Family Marginellidae (Margin Snails)

Common Atlantic marginella	*Prunum apicinum*

Family Melongenidae (Marine Snails)

Whelk

Family Planorbidae

Ramshorn	*Planorbella/Helisoma trivolvis*

APPENDIX B *continued*

Family Pleuroceridae	
Sharp hornsnail	*Pleurocera acuta*
hornsnail	*Pleurocera sublare*
Great Lakes hornsnail	*Goniobasis livescens*
Family Polygyridae	
Broad-banded forestsnail	*Allogona profunda*
White-lip globe	*Mesodon thyroidus*
Upland pillsnail	*Stenotrema/Euchemotrema fraternum*
Lowland pillsnail	*Stenotrema/Euchemotrema leai*
White-lip snail	*Triodopsis albolabris*
Northern three-tooth snail	*Triodopsis tridentata*
Family Strombidae (Marine Snails)	
Conch	
Family Succineidae	
Oval ambersnail	*Novisuccinea/Succinea ovalis*
Family Viviparidae	
Pointed campeloma	*Campeloma decisum*
Family Zonitidae	
Copper button	*Mesomphix cupreus*
Brittle button	*Mesomphix friabilis*
Amber glass	*Nesovitrea electrina/Retinella hammonis*

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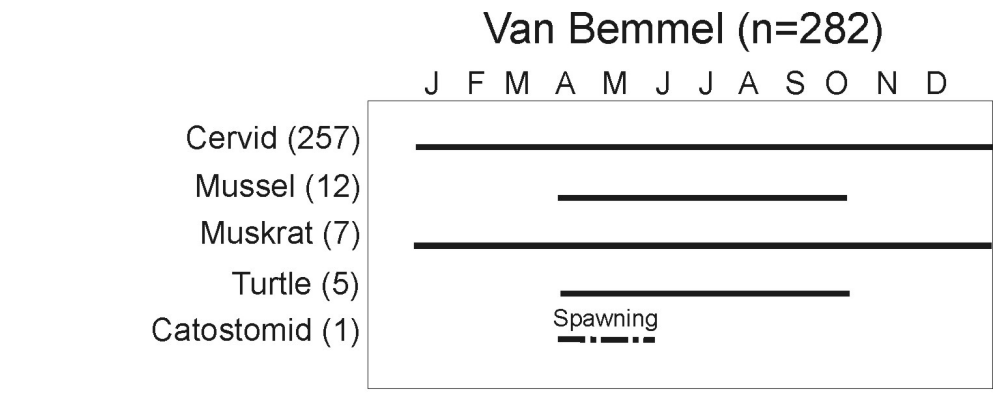
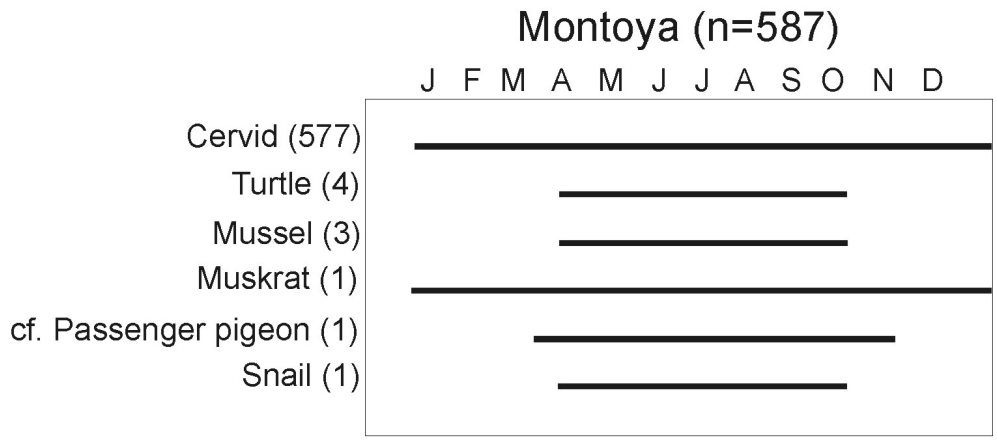
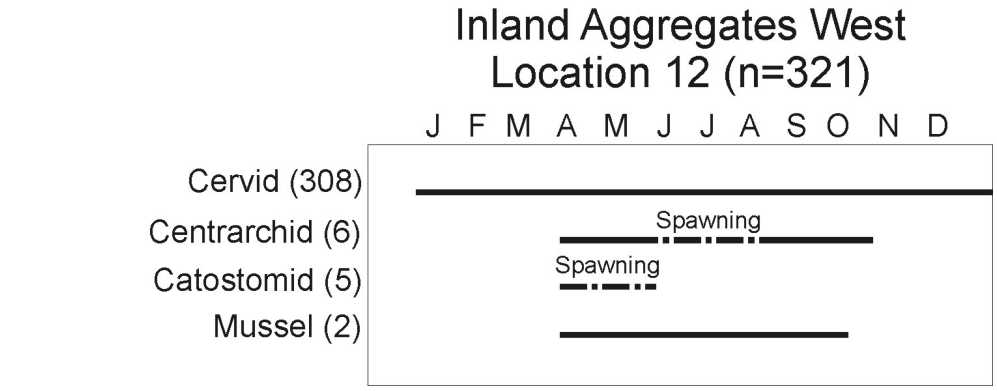
APPENDIX C: Taxonomic Category Representation at selected Western Basin Younge and Springwells sites

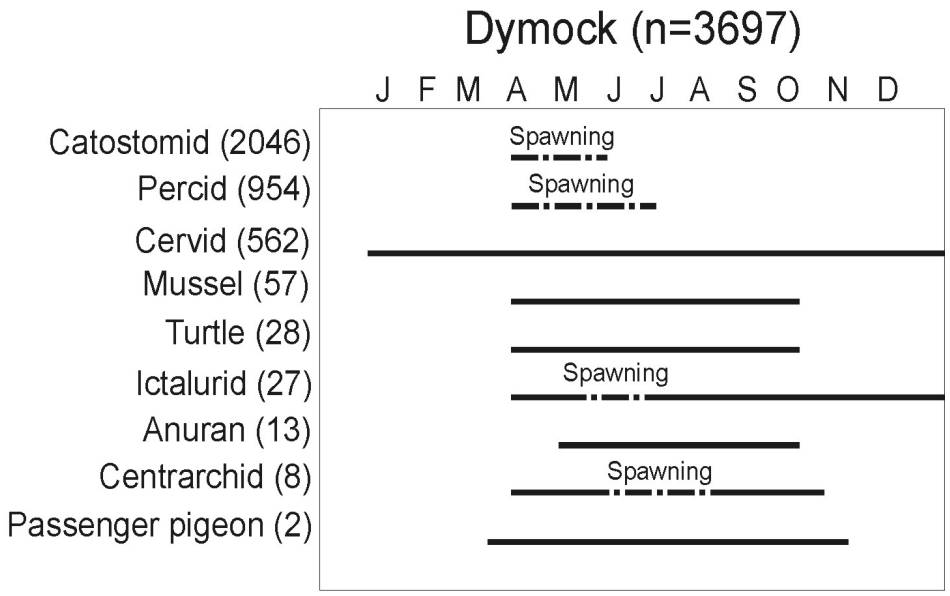


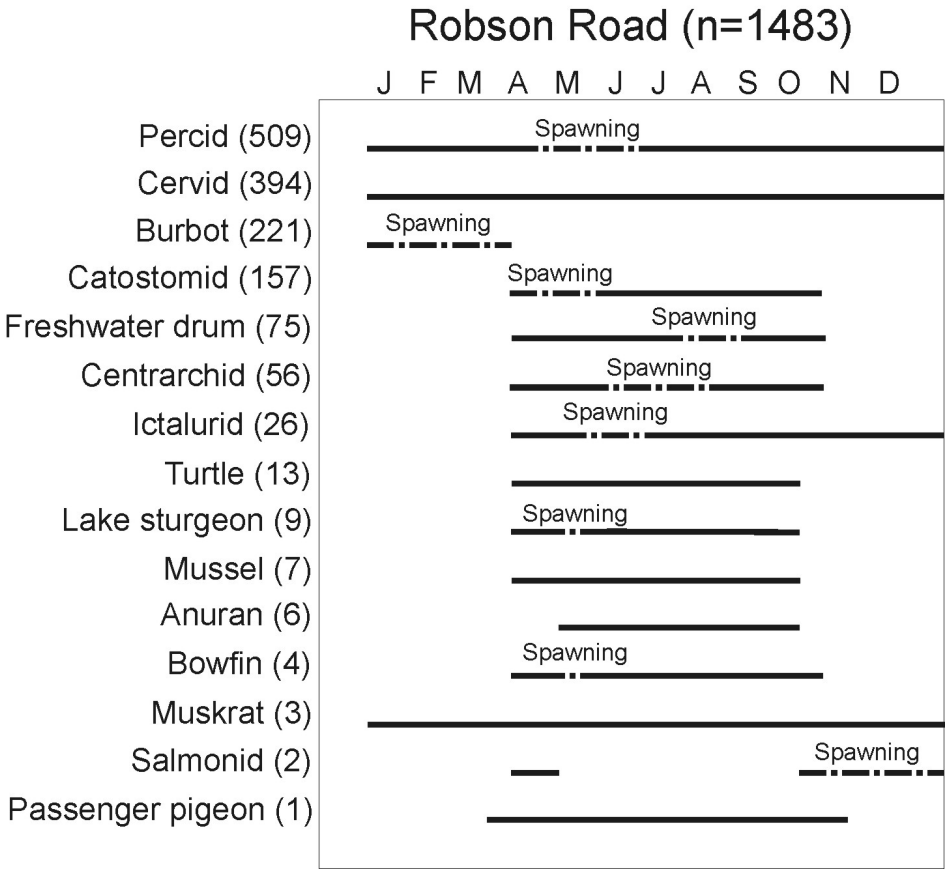




Note: n= the total number of indicator specimens identified in the assemblage.

APPENDIX C *continued*





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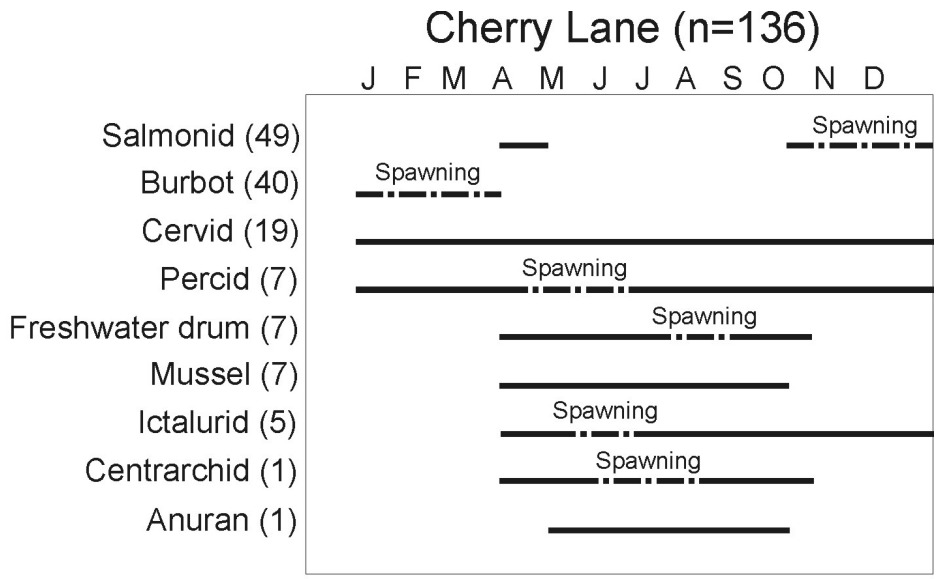

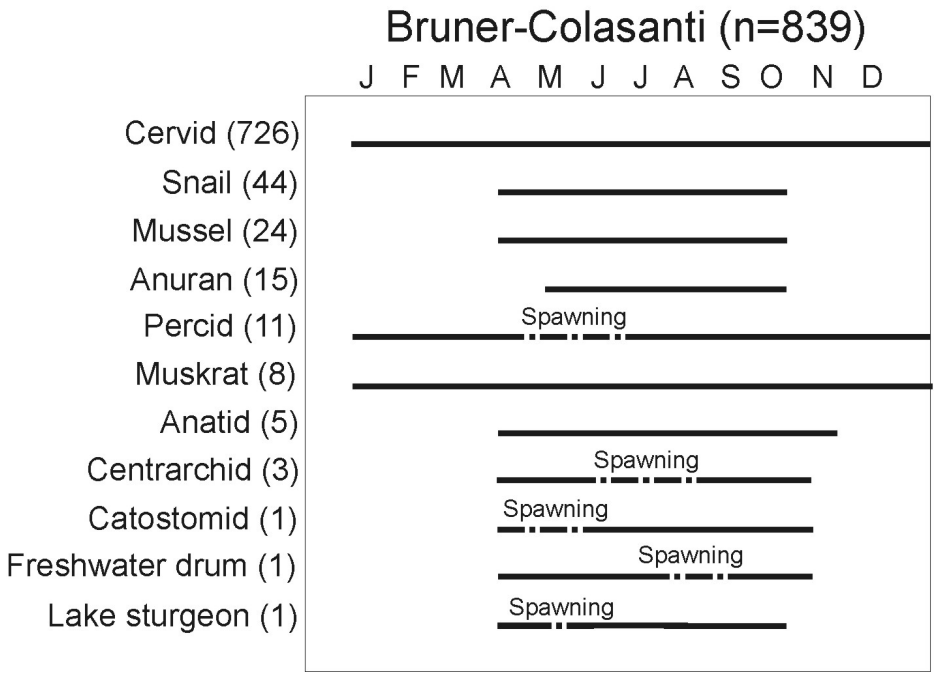

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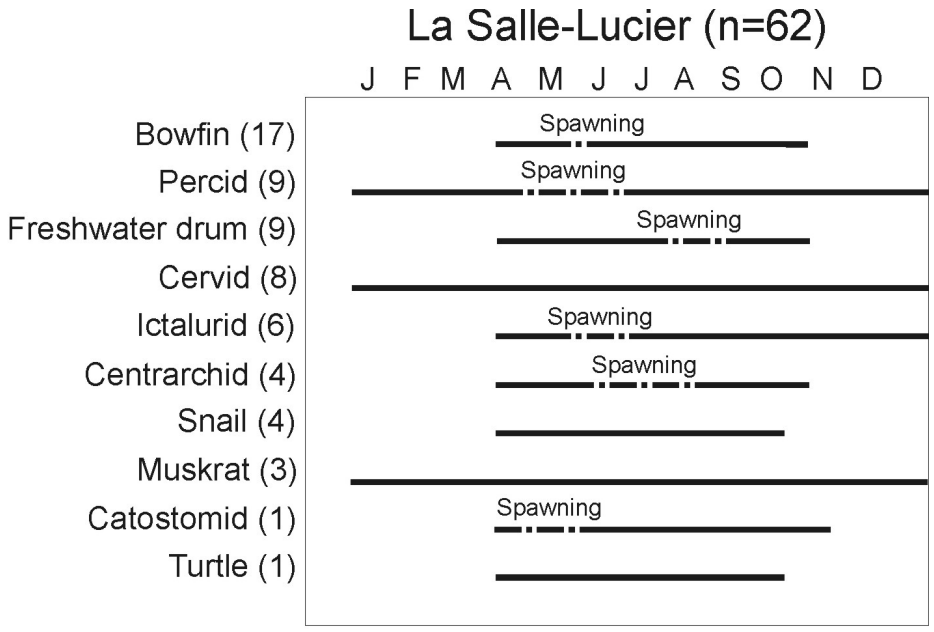

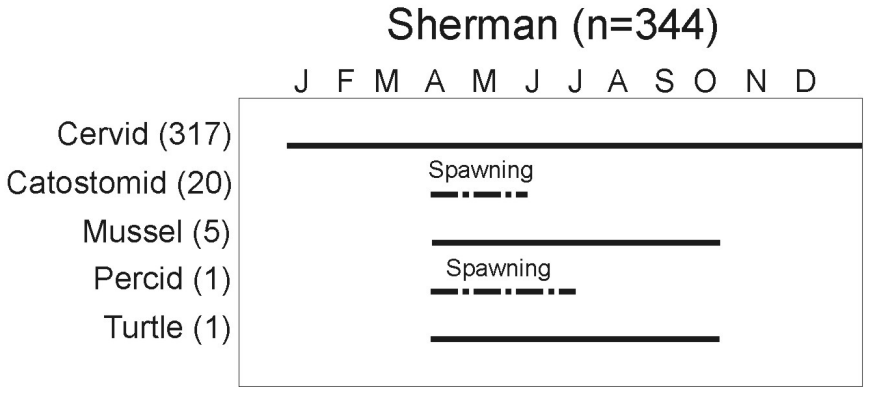

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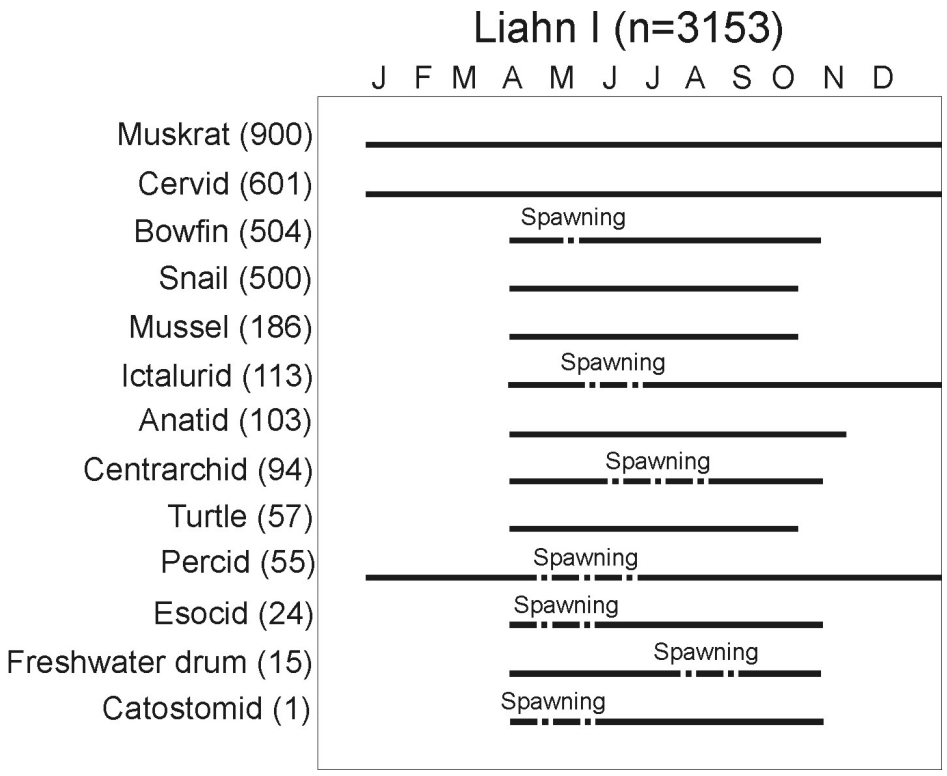

APPENDIX D: Southwestern Ontario Late Woodland Faunal Category Comparisons

Table I: Z-values Calculated from the Proportions of Class Categories to Examine Increases and Decreases in Class Exploitation Over Time within the Western Basin and Iroquoian datasets

Western Basin

Category	A.D. 800-1200	A.D. 1200-1600	Z-value	% Confidence Level
Mammal	75.13	53.22	64.72	100
Fish	23.82	41.07	52.19	100
Bird	0.48	2.29	22.22	100
Other	0.58	3.43	29.24	100
% Total	100	100	-	-
Total	42039	37869	-	-

Iroquoian

Category	A.D. 800-1200	A.D. 1200-1600	Z-value	% Confidence Level
Mammal	89.46	56.79	132.04	100
Fish	8.53	27.02	86.72	100
Bird	1.25	4.76	37.14	100
Other	0.77	11.43	81.47	100
% Total	100	100	-	-
Total	68123	56664	-	-

Note: Proportions are expressed as percentages. One-tailed % confidence level values are reported. The other category includes reptiles, amphibians, mussels, snails, and crustaceans.

Table II: Z-values Calculated from the Proportions of Main Mammal Taxa to Examine Increases and Decreases in Mammal Exploitation Over Time within the Western Basin and Iroquoian datasets

Western Basin

Category	A.D. 800-1200	A.D. 1200-1600	Z-value	% Confidence Level
Cervid	76.58	49.86	22.76	100
Raccoon	8.61	6.43	3.29	99.9
Squirrel	13.60	5.43	11.01	100
Muskrat/Beaver	1.21	38.28	39.82	100
% Total	100	100	-	-
Total	3809	2926	-	-

Iroquoian

Category	A.D. 800-1200	A.D. 1200-1600	Z-value	% Confidence Level
Cervid	87.03	79.63	16.77	100
Raccoon	3.15	2.38	3.93	100
Squirrel	7.04	11.05	11.80	100
Muskrat/Beaver	2.78	6.93	16.32	100
% Total	100	100	-	-
Total	14423	14122	-	-

Note: Proportions are expressed as percentages. One-tailed % confidence level values are reported. Cervid = white-tailed deer, elk, moose, and other cervid. Squirrel = eastern chipmunk, eastern gray squirrel, red squirrel, and other squirrel.

APPENDIX D *continued*

Table III: Z-values Calculated from the Proportions of Main Fish Taxa to Examine Increases and Decreases in Fish Exploitation Over Time within the Western Basin and Iroquoian datasets

Western Basin				
Category	**A.D. 800-1200**	**A.D. 1200-1600**	**Z-value**	**% Confidence Level**
Perciformes	41.73	50.48	7.04	100
Catostomid	55.53	3.42	44.06	100
Ictalurid	1.46	5.70	9.64	100
Salmonid	1.28	40.40	41.67	100
% Total	100	100	-	-
Total	3980	2718	-	-

Iroquoian				
Category	**A.D. 800-1200**	**A.D. 1200-1600**	**Z-value**	**% Confidence Level**
Perciformes	14.15	37.66	17.36	100
Catostomid	77.23	15.55	43.95	100
Ictalurid	5.65	43.90	27.86	100
Salmonid	2.97	2.90	0.05	52.1
% Total	100	100	-	-
Total	1682	3686	-	-

Note: Proportions are expressed as percentages. One-tailed % confidence level values are reported. Perciformes = perch-like fish order, Catostomid = sucker family, Ictalurid = catfish family, Salmonid = salmon family.

Table IV: Z-values Calculated from the Proportions of Main Bird Taxa to Examine Increases and Decreases in Bird Exploitation Over Time within the Western Basin and Iroquoian datasets

Western Basin				
Category	**A.D. 800-1200**	**A.D. 1200-1600**	**Z-value**	**% Confidence Level**
Columbid	4.30	48.36	7.40	100
Galliformes	90.32	4.51	15.52	100
Anatid	5.38	47.13	7.03	100
% Total	100	100	-	-
Total	93	244	-	-

Iroquoian				
Category	**A.D. 800-1200**	**A.D. 1200-1600**	**Z-value**	**% Confidence Level**
Columbid	25.62	64.25	10.22	100
Galliformes	66.50	21.80	12.92	100
Anatid	7.88	13.95	2.25	98.8
% Total	100	100	-	-
Total	203	1147	-	-

Note: Proportions are expressed as percentages. One-tailed % confidence level values are reported. Columbid = pigeon or dove, Galliformes = wild turkey, ruffed grouse, and other galliformes, Anatid = swans, geese, and ducks.

APPENDIX D *continued*

Table V: Z-values Calculated from the Proportions of Class Categories to Examine the Difference between Western Basin and Iroquoian Class Exploitation Over Time

	A.D. 800-1200			
Category	**Western Basin**	**Iroquoian**	**Z-value**	**% Confidence Level**
Mammal	75.13	89.46	63.00	100
Fish	23.82	8.53	70.29	100
Bird	0.48	1.25	12.73	100
Other	0.58	0.77	3.65	100
% Total	100	100	-	-
Total	42039	68123	-	-

	A.D. 1200-1600			
Category	**Western Basin**	**Iroquoian**	**Z-value**	**% Confidence Level**
Mammal	53.22	56.79	10.81	100
Fish	41.07	27.02	45.14	100
Bird	2.29	4.76	19.53	100
Other	3.43	11.43	43.86	100
% Total	100	100	-	-
Total	37869	56664	-	-

Note: Proportions are expressed as percentages. Two-tailed % confidence level values are reported.

Table VI: Z-values Calculated from the Proportions of Mammal, Fish, and Bird Taxa to Examine the Difference between Western Basin and Iroquoian Exploitation Over Time

	A.D. 800-1200			
Category	**Western Basin**	**Iroquoian**	**Z-value**	**% Confidence Level**
White-tailed deer	59.55	80.69	29.44	100
Squirrel	11.16	6.61	10.18	100
Woodchuck	2.97	1.26	7.92	100
American beaver	0.58	2.23	7.26	100
Northern raccoon	7.07	2.96	12.61	100
Centrarchid	1.74	5.40	7.69	100
Freshwater drum	1.95	0.64	3.57	100
Walleye/sauger	28.70	7.08	18.11	100
Yellow perch	4.70	0.52	7.89	100
Catostomid	51.94	75.39	16.65	100
Ictalurid	1.36	5.51	9.11	100
Whitefish/ lake herring	1.20	2.21	2.80	99.5
Burbot	6.13	0.46	9.51	100
Columbid	3.39	22.32	4.42	100
Wild turkey	61.02	48.93	2.03	95.8

APPENDIX D *continued*

Table VI Continued

	A.D. 1200-1600			
Category	**Western Basin**	**Iroquoian**	**Z-value**	**% Confidence Level**
White-tailed deer	39.60	56.43	17.77	100
Elk	0.12	1.84	7.23	100
Squirrel	4.79	9.14	8.22	100
Woodchuck	0.63	4.44	10.42	100
Common muskrat	33.06	3.17	57.94	100
American beaver	0.69	2.56	6.57	100
Northern raccoon	5.67	1.97	12.27	100
Centarchid	6.30	19.25	16.55	100
Freshwater drum	3.61	1.32	6.53	100
Walleye/sauger	16.00	8.43	10.20	100
Yellow perch	1.24	2.19	3.07	99.8
Catostomid	2.69	13.49	16.75	100
Pike	1.27	5.39	9.68	100
Bowfin	19.09	3.06	23.04	100
Ictalurid	4.48	38.08	34.85	100
Whitefish/ lake herring	29.23	1.65	34.65	100
Columbid	44.70	57.99	3.89	100
Wild turkey	3.79	9.13	2.75	99.4
Ruffed grouse	0	9.60	5.12	100
Anatid	43.56	12.59	11.85	100

Note: Proportions are expressed as percentages. Two-tailed % confidence level values are reported. Squirrel = eastern chipmunk, eastern gray squirrel, red squirrel, and other squirrel, Centrarchid = sunfish family, Catostomid = sucker family, Ictalurid = catfish family, Columbid = pigeon or dove, Anatid = swans, geese, and ducks.

APPENDIX E: Western Basin Large Mammal Datasets

Table I. Large Mammal Specimen Recovery at the Dobbelaar site

	NISP		Mass (g)	
Size	**6 mm mesh**	**Flotation**	**6 mm mesh**	**Flotation**
0-20 mm	57 (60.64)	37 (39.36)	10.3 (55.68)	8.2 (44.32)
20-30 mm	23 (76.67)	7 (23.33)	17.7 (85.51)	3 (14.49)
30-40 mm	13 (81.25)	3 (18.75)	12.2 (66.67)	6.1 (33.33)
40-50 mm	3 (100)	0	4.5 (100)	0
50-60 mm	2 (66.67)	1 (33.33)	2.2 (55.00)	1.8 (45.00)
60-80 mm	3 (100)	0	7.7 (100)	0
80-100 mm	1 (100)	0	5.2 (100)	0
>100 mm	0	0	0	0
Total	102	48	59.8	19.1

Note: The value in parenthesis represents the overall percentage of the assemblage represented by the category.

Table II. Fragment Size Summary by Number and Mass at Western Basin sites

	Montoya		IAW 12		Liahn I		Dobbelaar	
Size	**NISP**	**Mass (g)**	**NISP**	**Mass (g)**	**NISP**	**Mass (g)**	**NISP**	**Mass (g)**
0-20 mm	3946 (71.55)	847.60 (26.27)	810 (37.89)	157.30 (5.80)	1568 (76.67)	255.40 (22.53)	94 (62.67)	18.50 (23.45)
20-30 mm	1006 (18.24)	691.00 (21.42)	744 (34.80)	493.70 (18.20)	313 (15.31)	176.70 (15.59)	30 (20.00)	20.70 (26.24)
30-40 mm	314 (5.69)	456.40 (14.15)	342 (16.00)	612.20 (22.57)	92 (4.50)	140.10 (12.36)	16 (10.67)	18.30 (23.19)
40-50 mm	117 (2.12)	299.70 (9.29)	127 (5.94)	395.00 (14.56)	35 (1.71)	129.30 (11.41)	3 (2.00)	4.50 (5.70)
50-60 mm	48 (0.87)	191.60 (5.94)	57 (2.67)	352.20 (12.98)	18 (0.88)	97.40 (8.59)	3 (2.00)	4.00 (5.07)
60-80 mm	56 (1.02)	311.30 (9.65)	40 (1.87)	326.70 (12.04)	7 (0.34)	41.90 (3.70)	3 (2.00)	7.70 (9.76)
80-100 mm	17 (0.31)	181.40 (5.62)	6 (0.28)	57.50 (2.12)	6 (0.29)	87.30 (7.70)	1 (0.67)	5.20 (6.59)
>100 mm	11 (0.20)	246.90 (7.65)	12 (0.56)	317.90 (11.72)	6 (0.29)	205.60 (18.14)	0	0
Total	5515	3225.9	2138	2712.5	2045	1133.7	150	78.9

Note: IAW 12 = Inland Aggregates West Location 12. The value in parenthesis represents the overall percentage of the assemblage represented by the category.

APPENDIX E *continued*

Table III. Large Mammal Specimen Burning Score Summary at Western Basin sites

Degree of Burning	Montoya	IAW 12	Liahn I	Dobbelaar
0	3332 (60.42)	2030 (94.95)	1019 (49.83)	116 (77.33)
1	54 (0.98)	3 (0.14)	57 (2.79)	1 (0.67)
2	23 (0.42)	8 (0.37)	93 (4.55)	3 (2.00)
3	238 (4.32)	11 (0.51)	245 (11.98)	9 (6.0)
4	242 (4.39)	34 (1.59)	196 (9.58)	5 (3.33)
5	671 (12.17)	22 (1.03)	133 (6.50)	7 (4.67)
6	955 (17.32)	30 (1.40)	302 (14.77)	9 (6.00)
Total	5515	2138	2045	150

Note: The value in parenthesis represents the overall percentage of the assemblage represented by the category.

APPENDIX E *continued*

Table IV. Burning by Size Category at Western Basin sites

Montoya

Size	0	1	2	3	4	5	6
0-20 mm	2014 (60.44)	29 (53.70)	13 (56.52)	172 (72.27)	202 (83.47)	609 (90.76)	907 (94.97)
20-30 mm	791 (23.74)	13 (24.07)	8 (34.78)	54 (22.69)	32 (13.22)	61 (9.09)	47 (4.92)
30-40 mm	288 (8.64)	6 (11.11)	2 (8.70)	10 (4.20)	6 (2.48)	1 (0.15)	1 (0.10)
40-50 mm	109 (3.27)	4 (7.41)	0	2 (0.84)	2 (0.83)	0	0
50-60 mm	48 (1.44)	0	0	0	0	0	0
60-80 mm	55 (1.65)	1 (1.85)	0	0	0	0	0
80-100 mm	16 (0.48)	1 (1.85)	0	0	0	0	0
> 100 mm	11 (0.33)	0	0	0	0	0	0
Total	3332	54	23	238	242	671	955

IAW 12

Size	0	1	2	3	4	5	6
0-20 mm	731 (36.01)	1 (33.33)	4 (50.00)	6 (54.55)	24 (70.59)	20 (90.01)	24 (80.00)
20-30 mm	721 (35.52)	2 (66.67)	4 (50.00)	2 (18.18)	8 (23.53)	2 (9.09)	5 (16.67)
30-40 mm	337 (16.60)	0	0	2 (18.18)	2 (5.88)	0	1 (3.33)
40-50 mm	126 (6.21)	0	0	1 (9.09)	0	0	0
50-60 mm	57 (2.81)	0	0	0	0	0	0
60-80 mm	40 (1.97)	0	0	0	0	0	0
80-100 mm	6 (0.30)	0	0	0	0	0	0
> 100 mm	12 (0.59)	0	0	0	0	0	0
Total	2030	3	8	11	34	22	30

Liahn I

Size	0	1	2	3	4	5	6
0-20 mm	706 (69.28)	44 (77.19)	49 (52.69)	191 (77.96)	170 (86.73)	120 (90.23)	288 (95.36)
20-30 mm	194 (19.04)	7 (12.28)	28 (30.11)	41 (16.73)	22 (11.22)	10 (7.52)	11 (3.64)
30-40 mm	62 (6.08)	2 (3.51)	10 (10.75)	12 (4.90)	2 (1.02)	1 (0.75)	3 (0.99)
40-50 mm	25 (2.45)	2 (3.51)	4 (4.30)	1 (0.41)	2 (1.02)	1 (0.75)	0
50-60 mm	14 (1.37)	1 (1.75)	2 (2.15)	0	0	1 (0.75)	0
60-80 mm	6 (0.59)	1 (1.75)	0	0	0	0	0
80-100 mm	6 (0.59)	0	0	0	0	0	0
> 100 mm	6 (0.59)	0	0	0	0	0	0
Total	1019	57	93	245	196	133	302

Dobbelaar

Size	0	1	2	3	4	5	6
0-20 mm	63 (54.31)	0	3 (100.00)	7 (77.78)	5 (100.00)	7 (100.00)	9 (100.00)
20-30 mm	27 (23.28)	1 (100.00)	0	2 (22.22)	0	0	0
30-40 mm	16 (13.79)	0	0	0	0	0	0
40-50 mm	3 (2.59)	0	0	0	0	0	0
50-60 mm	3 (2.59)	0	0	0	0	0	0
60-80 mm	3 (2.59)	0	0	0	0	0	0
80-100 mm	1 (0.86)	0	0	0	0	0	0
> 100 mm	0	0	0	0	0	0	0
Total	116	1	3	9	5	7	9

Note: The value in parenthesis represents the overall percentage of the assemblage represented by the category.

APPENDIX E *continued*

Table V. Bone Size by Feature at Montoya and Liahn I

Montoya

Size	15	16	127	146	147	149
0-20 mm	106 (91.38)	1173 (72.63)	469 (54.85)	127 (85.81)	255 (86.73)	95 (86.36)
20-30 mm	9 (7.76)	314 (19.44)	219 (25.61)	17 (11.49)	24 (8.16)	14 (12.73)
30-40 mm	1 (0.86)	81 (5.02)	73 (8.54)	3 (2.03)	10 (3.40)	1 (0.91)
40-50 mm	0	25 (1.55)	46 (5.38)	1 (0.68)	2 (0.68)	0
50-60 mm	0	9 (0.56)	18 (2.11)	0	1 (0.34)	0
60-80 mm	0	10 (0.62)	22 (2.57)	0	1 (0.34)	0
80-100 mm	0	1 (0.06)	3 (0.35)	0	1 (0.34)	0
>100 mm	0	2 (0.12)	5 (0.58)	0	0	0
Total	116	1615	855	148	294	110

Size	150A	165	173	187	188	196
0-20 mm	282 (81.50)	199 (71.84)	127 (59.07)	62 (53.45)	72 (49.66)	90 (67.16)
20-30 mm	32 (9.25)	58 (20.94)	56 (26.05)	27 (23.28)	40 (27.59)	34 (25.37)
30-40 mm	17 (4.91)	15 (5.42)	26 (12.09)	13 (11.21)	10 (6.90)	5 (3.73)
40-50 mm	5 (1.45)	3 (1.08)	4 (1.86)	2 (1.72)	8 (5.52)	3 (2.24)
50-60 mm	5 (1.45)	1 (0.36)	1 (0.47)	5 (4.31)	5 (3.45)	2 (1.49)
60-80 mm	2 (0.58)	1 (0.36)	1 (0.47)	5 (4.31)	6 (4.14)	0
80-100 mm	3 (0.87)	0	0	1 (0.86)	3 (2.07)	0
>100 mm	0	0	0	1 (0.86)	1 (0.69)	0
Total	346	277	215	116	145	134

Liahn I

Size	19	36B	58B	75	79	92	95A
0-20 mm	191 (82.68)	132 (91.03)	127 (71.35)	343 (71.46)	146 (89.57)	94 (75.20)	59 (54.13)
20-30 mm	33 (14.29)	9 (6.21)	33 (18.54)	87 (18.13)	12 (7.36)	21 (16.80)	33 (30.28)
30-40 mm	5 (2.16)	3 (2.07)	7 (3.93)	30 (6.25)	4 (2.45)	7 (5.60)	10 (9.17)
40-50 mm	2 (0.87)	1 (0.69)	7 (3.93)	10 (2.08)	0	0	2 (1.83)
50-60 mm	0	0	3 (1.69)	5 (1.04)	0	1 (0.80)	2 (1.83)
60-80 mm	0	0	0	4 (0.83)	0	1 (0.80)	1 (0.92)
80-100 mm	0	0	1 (0.56)	0	0	0	1 (0.92)
>100 mm	0	0	0	1 (0.21)	1 (0.61)	1 (0.80)	1 (0.92)
Total	231	145	178	480	163	125	109

Note: The value in parenthesis represents the overall percentage of the assemblage represented by the category.

APPENDIX E *continued*

Table VI. Bone Type by Feature at Montoya and Liahn I

	Montoya					
Bone Type	**15**	**16**	**127**	**146**	**147**	**149**
Antler	0	0	0	0	0	0
Axial/Cranial Cancellous Bone	2 (1.72)	102 (6.32)	94 (10.99)	7 (4.73)	2 (0.68)	6 (5.45)
Tooth	0	43 (2.66)	45 (5.26)	0	0	4 (3.64)
Rib	0	58 (3.59)	107 (12.51)	0	0	0
Long Bone Articulations and Shaft	2 (1.72)	20 (1.24)	8 (0.94)	0	1 (0.34)	0
Cortical Long Bone Shaft	71 (61.21)	520 (32.20)	224 (26.20)	101 (68.24)	204 (69.39)	66 (60.00)
Small Compact Hand or Foot Bone	11 (9.48)	13 (0.80)	49 (5.73)	6 (4.05)	5 (1.70)	3 (2.73)
Indeterminate Cancellous Bone	1 (0.86)	574 (35.54)	0	30 (20.27)	52 (17.69)	18 (16.36)
Indeterminate Cancellous and Cortical Bone	29 (25.00)	235 (14.55)	328 (38.36)	0	30 (10.20)	11 (10.00)
Indeterminate Cortical Bone	0	50 (3.10)	0	4 (2.70)	0	2 (1.82)
Total	116	1615	855	148	294	110

Bone Type	**150A**	**165**	**173**	**187**	**188**	**196**
Antler	0	0	0	14 (12.07)	5 (3.45)	0
Axial/Cranial Cancellous Bone	11 (3.18)	0	30 (13.95)	7 (6.03)	7 (4.83)	10 (7.46)
Tooth	52 (15.03)	14 (5.05)	3 (1.40)	0	2 (1.38)	0
Rib	4 (1.16)	8 (2.89)	21 (9.77)	4 (3.45)	0	8 (5.97)
Long Bone Articulations and Shaft	0	8 (2.89)	10 (4.65)	3 (2.57)	3 (2.07)	0
Cortical Long Bone Shaft	184 (53.18)	134 (48.38)	71 (33.02)	70 (60.34)	95 (65.52)	75 (55.97)
Small Compact Hand or Foot Bone	4 (1.16)	20 (7.22)	3 (1.40)	4 (3.45)	5 (3.45)	2 (1.49)
Indeterminate Cancellous Bone	57 (16.47)	23 (8.30)	69 (32.09)	6 (5.17)	10 (6.90)	20 (14.93)
Indeterminate Cancellous and Cortical Bone	30 (8.67)	50 (18.05)	8 (3.72)	2 (1.72)	18 (12.41)	10 (7.46)
Indeterminate Cortical Bone	4 (1.16)	20 (7.22)	0	6 (5.17)	0	9 (6.72)
Total	346	277	215	116	145	134

Note: The value in parenthesis represents the overall percentage of the assemblage represented by the category.

APPENDIX E *continued*

Table VI. continued

	Liahn I						
Bone Type	**19**	**36B**	**58B**	**75**	**79**	**92**	**95A**
Antler	0	0	60 (33.71)	0	2 (1.23)	1 (0.80)	5 (4.59)
Axial/Cranial Cancellous Bone	1 (0.43)	0	3 (1.69)	23 (4.79)	2 (1.23)	8 (6.40)	0
Tooth	9 (3.90)	0	0	4 (0.83)	0	0	3 (2.75)
Rib	0	0	0	18 (3.75)	6 (3.68)	0	0
Long Bone Articulations and Shaft	1 (0.43)	1 (0.69)	1 (0.56)	4 (0.83)	0	2 (1.60)	1 (0.92)
Cortical Long Bone Shaft	77 (33.33)	26 (17.93)	12 (6.74)	107 (22.29)	37 (22.70)	51 (40.80)	79 (72.48)
Small Compact Hand or Foot Bone	2 (0.87)	1 (0.69)	2 (1.12)	4 (0.83)	3 (1.84)	0	0
Indeterminate Cancellous Bone	19 (8.23)	9 (6.21)	34 (19.10)	55 (11.46)	51 (31.29)	26 (20.80)	8 (7.34)
Indeterminate Cancellous and Cortical Bone	0	95 (65.52)	26 (14.61)	42 (8.75)	0	17 (13.60)	1 (0.92)
Indeterminate Cortical Bone	122 (52.81)	13 (8.97)	40 (22.47)	223 (46.46)	62 (38.04)	20 (16.00)	12 (11.01)
Total	231	145	178	480	163	125	109

Note: The value in parenthesis represents the overall percentage of the assemblage represented by the category.

APPENDIX E *continued*

Table VII. Bone Type by Size Category for Montoya Features

Axial	15	16	127	146	147	149
0-20 mm	2 (1.72)	64 (4.07)	76 (9.38)	5 (3.38)	0	5 (4.72)
20-30 mm	0	56 (3.56)	73 (9.01)	2 (1.35)	1 (0.34)	1 (0.94)
30-40 mm	0	23 (1.46)	25 (3.09)	0	1 (0.34)	0
40-50 mm	0	11 (0.70)	13 (1.60)	0	0	0
50-60 mm	0	1 (0.06)	5 (0.62)	0	0	0
60-80 mm	0	4 (0.25)	8 (0.99)	0	0	0
80-100 mm	0	0	0	0	0	0
>100 mm	0	1 (0.06)	1 (0.12)	0	0	0
Total	2 (1.72)	160 (10.18)	201 (24.81)	7 (4.73)	2 (0.68)	6 (5.66)
Appendicular	**15**	**16**	**127**	**146**	**147**	**149**
0-20 mm	74 (63.79)	333 (21.18)	74 (9.14)	91 (61.49)	178 (60.54)	57 (53.77)
20-30 mm	9 (7.76)	144 (9.16)	95 (11.73)	12 (8.11)	18 (6.12)	11 (10.38)
30-40 mm	1 (0.86)	49 (3.12)	45 (5.56)	3 (2.03)	9 (3.06)	1 (0.94)
40-50 mm	0	11 (0.70)	33 (4.07)	1 (0.68)	2 (0.68)	0
50-60 mm	0	8 (0.51)	13 (1.60)	0	1 (0.34)	0
60-80 mm	0	6 (0.38)	14 (1.73)	0	1 (0.34)	0
80-100 mm	0	1 (0.06)	3 (0.37)	0	1 (0.34)	0
>100 mm	0	1 (0.06)	4 (0.49)	0	0	0
Total	84 (72.41)	553 (35.18)	281 (34.69)	107 (72.30)	210 (71.43)	69 (65.09)
Indeterminate	**15**	**16**	**127**	**146**	**147**	**149**
0-20 mm	30 (25.86)	742 (47.20)	281 (34.69)	31 (20.95)	77 (26.19)	29 (27.36)
20-30 mm	0	106 (6.74)	44 (5.43)	3 (2.03)	5 (1.70)	2 (1.89)
30-40 mm	0	8 (0.51)	3 (0.37)	0	0	0
40-50 mm	0	3 (0.19)	0	0	0	0
50-60 mm	0	0	0	0	0	0
60-80 mm	0	0	0	0	0	0
80-100 mm	0	0	0	0	0	0
>100 mm	0	0	0	0	0	0
Total	30 (25.86)	859 (54.64)	328 (40.49)	34 (22.97)	82 (27.89)	31 (29.25)
Feature Total	116	1572	810	148	294	106

Note: The value in parenthesis represents the percentage of the total number of large mammal specimens within the feature. Tooth fragments have been removed from the axial bone category to produce a more accurate representation.

APPENDIX E *continued*

Table VII. continued

Axial	150A	165	173	187	188	196
0-20 mm	12 (4.08)	7 (2.66)	29 (13.68)	11 (9.48)	3 (2.10)	10 (7.46)
20-30 mm	1 (0.34)	1 (0.38)	14 (6.60)	4 (3.45)	2 (1.40)	5 (3.73)
30-40 mm	0	0	8 (3.77)	5 (4.31)	2 (1.40)	0
40-50 mm	0	0	0	1 (0.86)	0	1 (0.75)
50-60 mm	0	0	0	3 (2.59)	2 (1.40)	2 (1.49)
60-80 mm	1 (0.34)	0	0	1 (0.86)	0	0
80-100 mm	1 (0.34)	0	0	0	2 (1.40)	0
>100 mm	0	0	0	0	1 (0.70)	0
Total	15 (5.10)	8 (3.04)	51 (24.06)	25 (21.55)	12 (8.39)	18 (13.43)
Appendicular	**150A**	**165**	**173**	**187**	**188**	**196**
0-20 mm	135 (45.92)	104 (39.54)	40 (18.87)	43 (37.07)	47 (32.87)	50 (37.31)
20-30 mm	24 (8.16)	41 (15.59)	25 (11.79)	18 (15.52)	30 (20.98)	20 (14.92)
30-40 mm	16 (5.44)	12 (4.56)	14 (6.60)	7 (6.03)	8 (5.59)	5 (3.73)
40-50 mm	5 (1.70)	3 (1.14)	3 (1.42)	1 (0.86)	8 (5.59)	2 (1.49)
50-60 mm	5 (1.70)	1 (0.38)	1 (0.47)	2 (1.72)	3 (2.10)	0
60-80 mm	1 (0.34)	1 (0.38)	1 (0.47)	4 (3.45)	6 (4.20)	0
80-100 mm	2 (0.68)	0	0	1 (0.86)	1 (0.70)	0
>100 mm	0	0	0	1 (0.86)	0	0
Total	188 (63.95)	162 (61.60)	84 (39.62)	77 (66.38)	103 (72.03)	77 (57.46)
Indeterminate	**150A**	**165**	**173**	**187**	**188**	**196**
0-20 mm	88 (29.93)	77 (29.28)	56 (26.42)	8 (6.90)	21 (14.69)	30 (22.39)
20-30 mm	2 (0.68)	13 (4.94)	16 (7.55)	5 (4.31)	7 (4.90)	9 (6.72)
30-40 mm	1 (0.34)	3 (1.14)	4 (1.89)	1 (0.86)	0	0
40-50 mm	0	0	1 (0.47)	0	0	0
50-60 mm	0	0	0	0	0	0
60-80 mm	0	0	0	0	0	0
80-100 mm	0	0	0	0	0	0
>100 mm	0	0	0	0	0	0
Total	91 (30.95)	93 (35.36)	77 (36.32)	14 (12.07)	28 (19.58)	39 (29.10)
Feature Total	294	263	212	116	143	134

Note: The value in parenthesis represents the percentage of the total number of large mammal specimens within the feature. Tooth fragments have been removed from the axial bone category to produce a more accurate representation.

APPENDIX E *continued*

Table VIII. Bone Type by Size Category for Liahn I Features

Axial	19	36B	58B	75	79	92	95A
0-20 mm	1 (0.45)	0	38 (21.35)	17 (3.57)	6 (3.68)	5 (4.00)	0
20-30 mm	0	0	11 (6.18)	12 (2.52)	2 (1.23)	2 (1.60)	0
30-40 mm	0	0	5 (2.81)	8 (1.68)	2 (1.23)	1 (0.80)	1 (0.94)
40-50 mm	0	0	7 (3.93)	2 (0.42)	0	0	1 (0.94)
50-60 mm	0	0	1 (0.56)	2 (0.42)	0	0	1 (0.94)
60-80 mm	0	0	0	0	0	0	1 (0.94)
80-100 mm	0	0	1 (0.56)	0	0	0	1 (0.94)
>100 mm	0	0	0	0	0	1 (0.80)	0
Total	1 (0.45)	0	63 (35.39)	41 (8.61)	10 (6.13)	9 (7.20)	5 (4.72)
Appendicular	**19**	**36B**	**58B**	**75**	**79**	**92**	**95A**
0-20 mm	50 (22.52)	22 (15.17)	10 (5.62)	61 (12.82)	29 (17.79)	36 (28.80)	56 (52.83)
20-30 mm	23 (10.36)	3 (2.07)	4 (2.25)	25 (5.25)	8 (4.91)	13 (10.40)	18 (16.98)
30-40 mm	5 (2.25)	2 (1.38)	0	15 (3.15)	2 (1.23)	2 (1.60)	4 (3.77)
40-50 mm	2 (0.90)	1 (0.69)	0	6 (1.26)	0	0	0
50-60 mm	0	0	1 (0.56)	3 (0.63)	0	1 (0.80)	1 (0.94)
60-80 mm	0	0	0	4 (0.84)	0	1 (0.80)	0
80-100 mm	0	0	0	0	0	0	0
>100 mm	0	0	0	1 (0.21)	1 (0.61)	0	1 (0.94)
Total	80 (36.04)	28 (19.31)	15 (8.43)	115 (24.16)	40 (24.54)	53 (42.40)	80 (75.47)
Indeterminate	**19**	**36B**	**58B**	**75**	**79**	**92**	**95A**
0-20 mm	131 (59.01)	110 (75.86)	79 (44.38)	263 (55.25)	111 (68.10)	53 (42.40)	7 (6.60)
20-30 mm	10 (4.50)	6 (4.14)	18 (10.11)	48 (10.08)	2 (1.23)	6 (4.80)	8 (7.55)
30-40 mm	0	1 (0.69)	2 (1.12)	7 (1.47)	0	4 (3.20)	5 (4.72)
40-50 mm	0	0	0	2 (0.42)	0	0	1 (0.94)
50-60 mm	0	0	1 (0.56)	0	0	0	0
60-80 mm	0	0	0	0	0	0	0
80-100 mm	0	0	0	0	0	0	0
>100 mm	0	0	0	0	0	0	0
Total	141 (63.51)	117 (80.69)	100 (56.18)	320 (67.23)	113 (69.33)	63 (50.40)	21 (19.81)
Feature Total	222	145	178	476	163	125	106

Note: The value in parenthesis represents the percentage of the total number of large mammal specimens within the feature. Tooth fragments have been removed from the axial bone category to produce a more accurate representation.

APPENDIX E *continued*

Table IX. Burning Category by Feature at Montoya and Liahn I

	Montoya					
Burning Category	**15**	**16**	**127**	**146**	**147**	**149**
0	2 (1.72)	1449 (89.72)	845 (98.83)	14 (9.46)	22 (7.48)	20 (18.18)
1	0	1 (0.06)	8 (0.94)	3 (2.03)	4 (1.36)	0
2	2 (1.72)	0	1 (0.12)	1 (0.68)	1 (0.34)	0
3	5 (4.31)	5 (0.31)	0	6 (4.05)	20 (6.80)	2 (1.82)
4	28 (24.14)	18 (1.11)	0	11 (7.43)	42 (14.29)	10 (9.09)
5	59 (50.86)	42 (2.60)	1 (0.12)	46 (31.08)	120 (40.82)	38 (34.55)
6	20 (17.24)	100 (6.19)	0	67 (45.27)	85 (28.91)	40 (36.36)
Total	116	1615	855	148	294	110

Burning Category	**150A**	**165**	**173**	**187**	**188**	**196**
0	128 (36.99)	71 (25.63)	197 (91.63)	70 (60.34)	88 (60.69)	44 (32.84)
1	0	11 (3.97)	0	0	11 (7.59)	3 (2.24)
2	0	6 (2.17)	0	0	0	2 (1.49)
3	8 (2.31)	53 (19.13)	6 (2.79)	0	0	10 (7.46)
4	9 (2.60)	45 (16.25)	3 (1.40)	9 (7.76)	3 (2.07)	10 (7.46)
5	47 (13.58)	57 (20.58)	5 (2.33)	9 (7.76)	13 (8.97)	28 (20.90)
6	154 (44.51)	34 (12.27)	4 (1.86)	28 (24.14)	30 (20.69)	37 (27.61)
Total	346	277	215	116	145	134

	Liahn I						
Burning Category	**19**	**36B**	**58B**	**75**	**79**	**92**	**95A**
0	182 (78.79)	23 (15.86)	65 (36.52)	240 (50.00)	32 (19.63)	63 (50.40)	65 (59.63)
1	0	0	5 (2.81)	27 (5.63)	4 (2.45)	6 (4.80)	0
2	3 (1.30)	1 (0.69)	17 (9.55)	16 (3.33)	3 (1.84)	1 (0.80)	13 (11.93)
3	20 (8.66)	3 (2.07)	13 (7.30)	98 (20.42)	63 (38.65)	3 (2.40)	3 (2.75)
4	7 (3.03)	6 (4.14)	35 (19.66)	49 (10.21)	37 (22.70)	9 (7.20)	10 (9.17)
5	2 (0.87)	6 (4.14)	16 (8.99)	24 (5.00)	15 (9.20)	19 (15.20)	7 (6.42)
6	17 (7.36)	106 (73.10)	27 (15.17)	26 (5.42)	9 (5.52)	24 (19.20)	11 (10.09)
Total	231	145	178	480	163	125	109

Note: The value in parenthesis represents the overall percentage of the assemblage represented by the category.

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